

Report on the FCC and IC Testing of the: Apple Inc. Model: A1932

In accordance with FCC 47 CFR Part 15C and
Industry Canada RSS-247 and Industry Canada
RSS-GEN

Prepared for: Apple Inc.
One Apple Park Way
Cupertino
California 95014
USA

FCC ID: BCGA1932

IC: 579C-A1932



Product Service

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Document Number: 75942371-10 | Issue: 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Matthew Russell	RF Team Leader	Authorised Signatory	17 October 2018

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15E and Industry Canada RSS-247 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Daniel Bishop	Assistant Engineer	Testing	17 October 2018
Sharif Sendagire	Shift Engineer	Testing	17 October 2018
Graeme Lawler	Test Engineer	Testing	17 October 2018
Nandhini Mathivanan	Engineer	Testing	17 October 2018
Jay Balendrarajah	Shift Engineer	Testing	17 October 2018
Tony Hubbard	Test Engineer	Testing	17 October 2018

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15E: 2017, Industry Canada RSS-247: Issue 2 (2017-02) and Industry Canada RSS-GEN: Issue 5 (2018-04).



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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	17 October 2018

Table 1

1.2 Introduction

Applicant	Apple Inc.
Manufacturer	Apple Inc.
Model Number(s)	A1932
Serial Number(s)	C02X5004JL9H and C02WG001JV8M
Hardware Version(s)	EVT2
Software Version(s)	18B2034
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C, Industry Canada RSS-247 and Industry Canada RSS-GEN: 2016 and Issue 2 (2017-02) and Issue 4 (2014-11)
Order Number	0540166213
Date	06-April-2018
Date of Receipt of EUT	23-August 2018
Start of Test	07-September-2018
Finish of Test	27-September-2018
Name of Engineer(s)	Daniel Bishop, Sharif Sendagire, Graeme Lawler, Tony Hubbard, Nandhini Mathivanan and Jay Balendrarajah
Related Document(s)	ANSI C63.10 (2013)



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C and Industry Canada RSS-247 and Industry Canada RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	15.247	RSS-247	RSS-GEN			
Configuration and Mode: Bluetooth BDR/EDR - iPA						
2.1	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Average Time of Occupancy	Pass	ANSI C63.10 (2013)
2.2	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Channel Separation	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Number of Hopping Channels	Pass	ANSI C63.10 (2013)
2.4	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - 20 dB Bandwidth	Pass	ANSI C63.10 (2013)
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.6	15.205	*	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.7	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
2.8	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)

Table 2



Product Service

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	15.247	RSS-247	RSS-GEN			
Configuration and Mode: Bluetooth EDR - ePA						
2.1	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Average Time of Occupancy	Pass	ANSI C63.10 (2013)
2.2	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Channel Separation	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Number of Hopping Channels	Pass	ANSI C63.10 (2013)
2.4	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - 20 dB Bandwidth	Pass	ANSI C63.10 (2013)
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.6	15.205	*	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.7	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
2.8	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)

Table 3



1.4 Product Information

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Laptop computer, with Bluetooth, Bluetooth Low Energy and 802.11 b/g/n/ac capabilities in the 2.4GHz and 5GHz bands.

1.5 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: C02WG001JV8M			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: C02X5004JL9H			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 4



1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Bluetooth BDR/EDR - iPA		
Frequency Hopping Systems - Average Time of Occupancy	Daniel Bishop	UKAS
Frequency Hopping Systems - Channel Separation	Daniel Bishop	UKAS
Frequency Hopping Systems - Number of Hopping Channels	Daniel Bishop	UKAS
Frequency Hopping Systems - 20 dB Bandwidth	Daniel Bishop	UKAS
Authorised Band Edges	Sharifu Sendagire, Graeme Lawler, Tony Hubbard, Nandhini Mathivanan, Jay Balendrarajah	UKAS
Restricted Band Edges		UKAS
Spurious Radiated Emissions		UKAS
Maximum Conducted Output Power	Daniel Bishop	UKAS
Configuration and Mode: Bluetooth EDR - ePA		
Frequency Hopping Systems - Average Time of Occupancy	Daniel Bishop	UKAS
Frequency Hopping Systems - Channel Separation	Daniel Bishop	UKAS
Frequency Hopping Systems - Number of Hopping Channels	Daniel Bishop	UKAS
Frequency Hopping Systems - 20 dB Bandwidth	Daniel Bishop	UKAS
Authorised Band Edges	Sharifu Sendagire, Graeme Lawler, Tony Hubbard, Nandhini Mathivanan, Jay Balendrarajah	UKAS
Restricted Band Edges		UKAS
Spurious Radiated Emissions		UKAS
Maximum Conducted Output Power	Daniel Bishop	UKAS

Table 5

Office Address:

Octagon House
 Concorde Way
 Segensworth North
 Fareham
 Hampshire
 PO15 5RL
 United Kingdom



2 Test Details

2.1 Frequency Hopping Systems - Average Time of Occupancy

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
Industry Canada RSS-247, Clause 5.1

2.1.2 Equipment Under Test and Modification State

A1932, S/N: C02X5004JL9H - Modification State 0

2.1.3 Date of Test

25-September-2018

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.4.

2.1.5 Environmental Conditions

Ambient Temperature 26.7 - 27.0 °C
Relative Humidity 26.5 - 27.8 %

2.1.6 Test Results

Bluetooth BDR/EDR - iPA

Packet Type	Dwell Time (ms)	Number of Transmissions	Average Occupancy Time (ms)
DH5	2.870	88	252.56
2DH5	2.880	88	253.44
3DH5	2.880	82	236.16

Table 6



Product Service

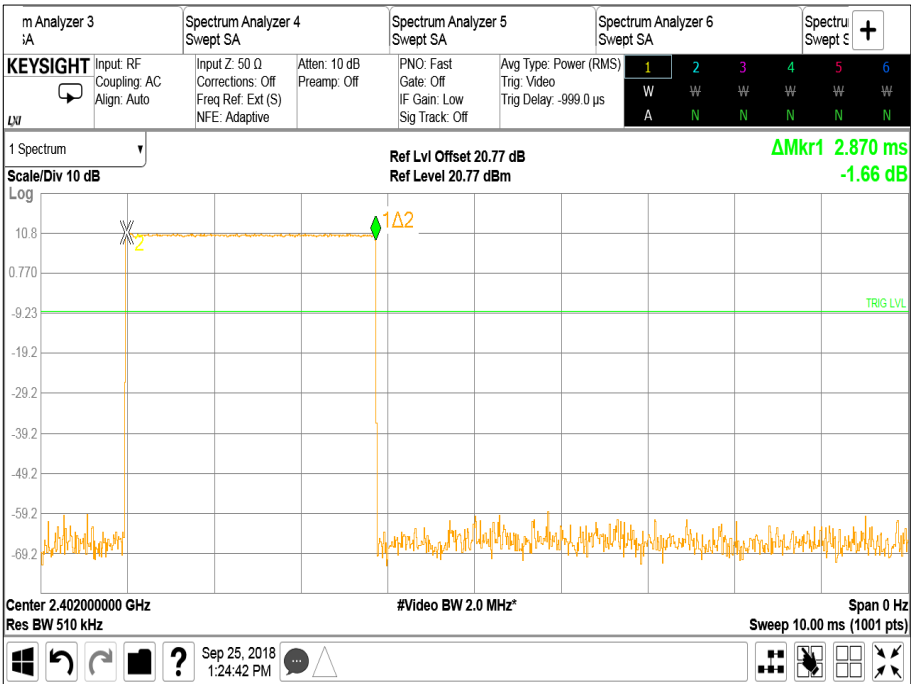


Figure 1 - DH5, Dwell Time



Figure 2 - DH5, Total Average Time of Occupancy



Product Service

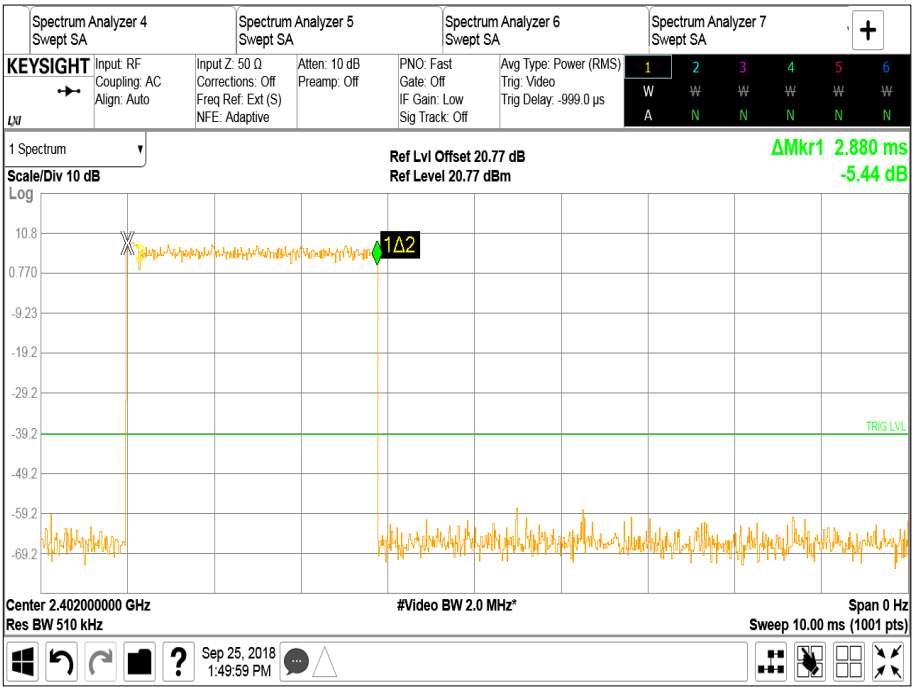


Figure 3 - 2DH5, Dwell Time

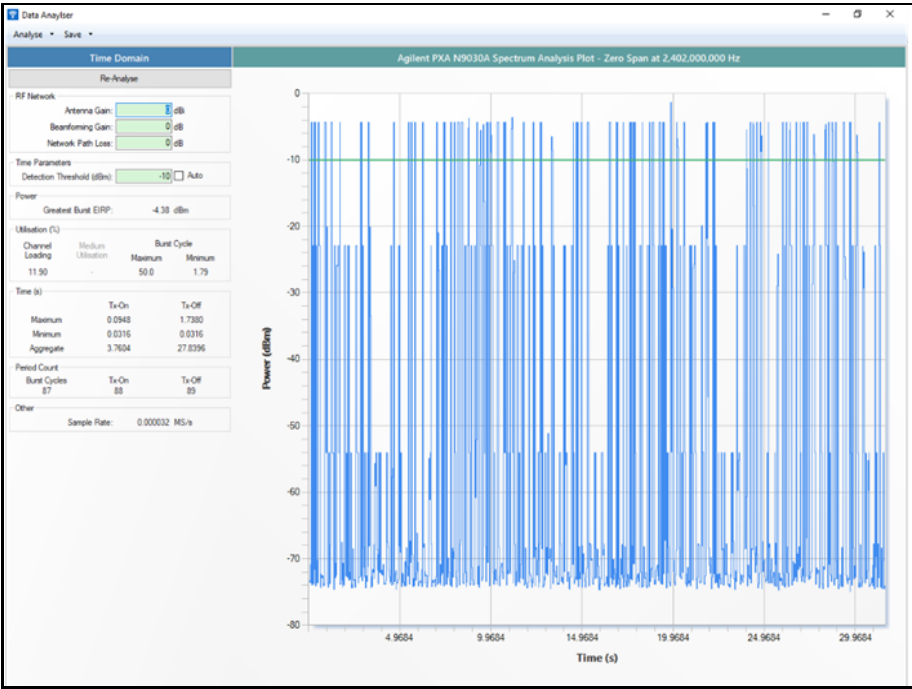


Figure 4 - 2DH5, Total Average Time of Occupancy



Product Service

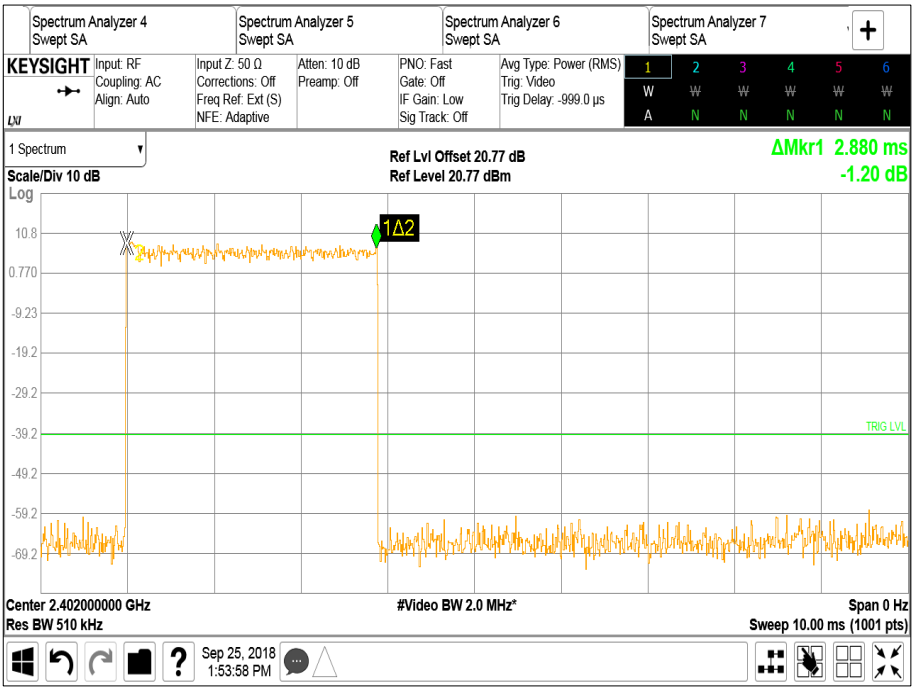


Figure 5 - 3DH5, Dwell Time

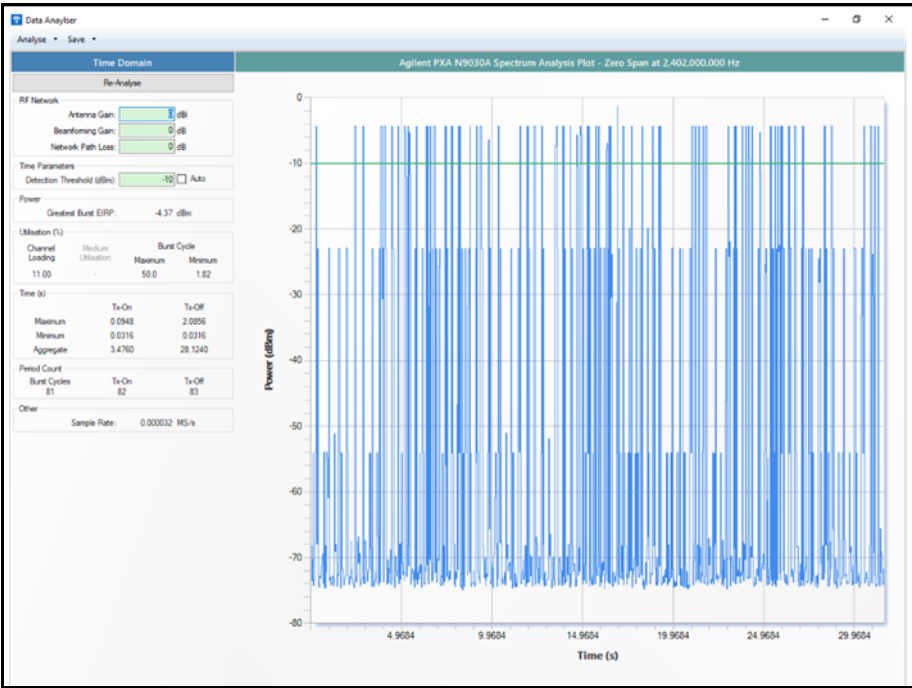


Figure 6 - 3DH5, Total Average Time of Occupancy



Product Service

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)

Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

Industry Canada RSS-247, Limit Clause 5.1 (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed.



Product Service

Bluetooth EDR - ePA

Packet Type	Dwell Time (ms)	Number of Transmissions	Average Occupancy Time (ms)
2DH5	2.880	77	221.76
3DH5	2.880	75	216.00

Table 7

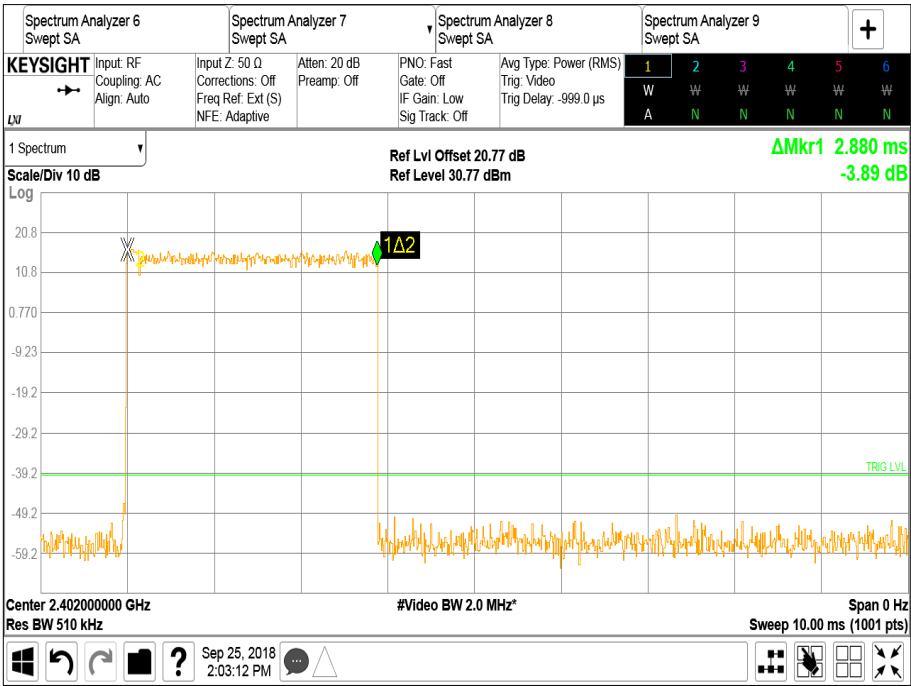


Figure 7 - 2DH5, Dwell Time

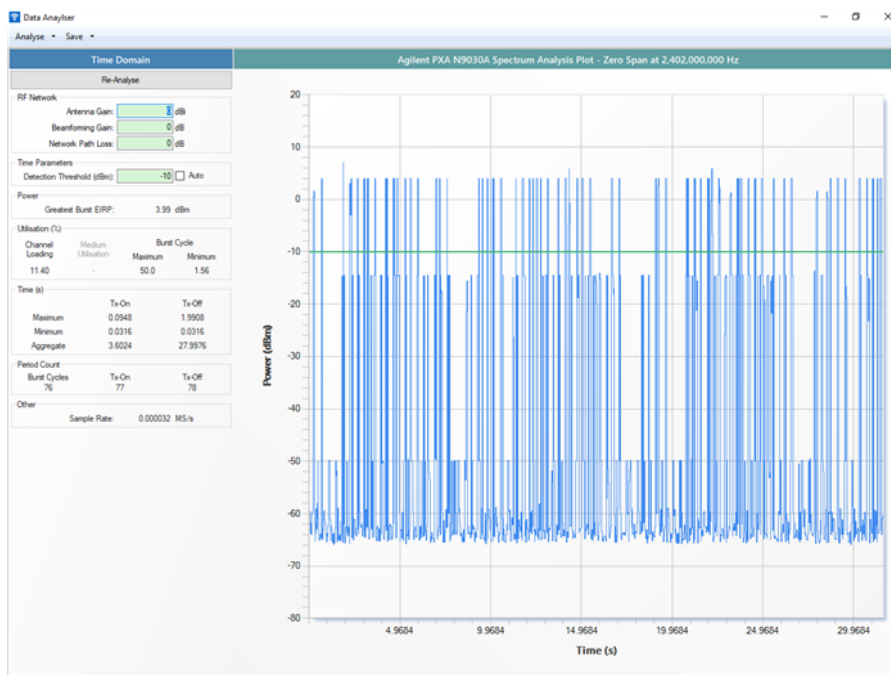


Figure 8 - 2DH5, Total Average Time of Occupancy

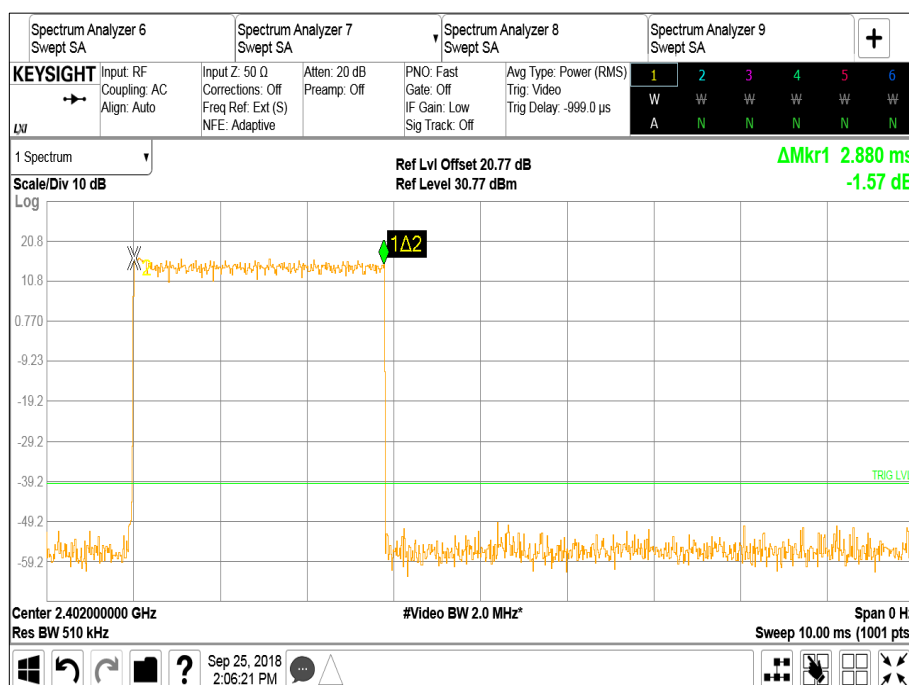


Figure 9 - 3DH5, Dwell Time



Product Service

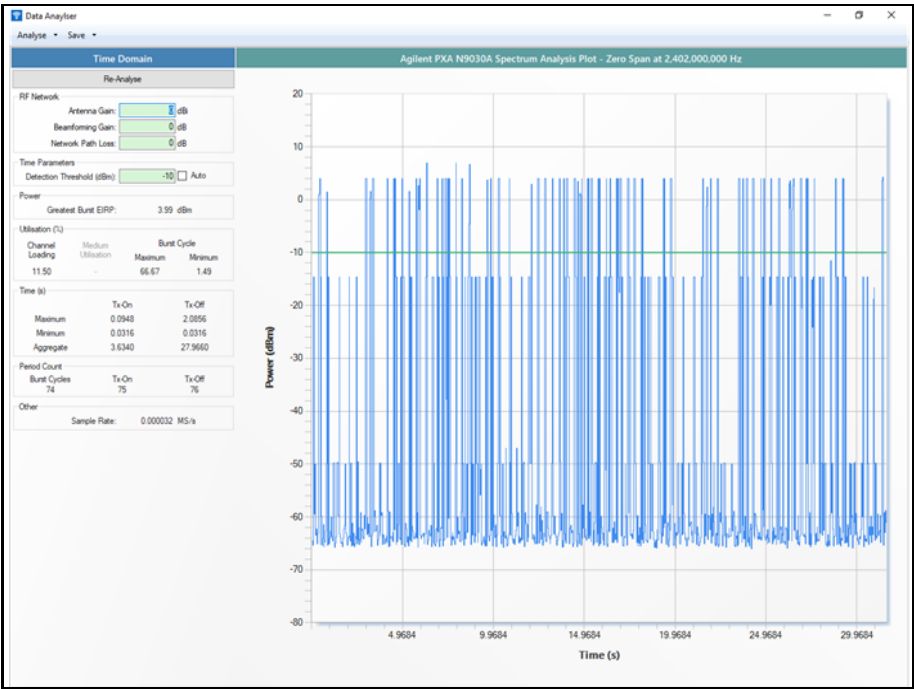


Figure 10 - 3DH5, Total Average Time of Occupancy

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)

Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

Industry Canada RSS-247, Limit Clause 5.1 (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed.



2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 8



2.2 Frequency Hopping Systems - Channel Separation

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
Industry Canada RSS-247, Clause 5.1

2.2.2 Equipment Under Test and Modification State

A1932, S/N: C02X5004JL9H - Modification State 0

2.2.3 Date of Test

26-September-2018

2.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.2.

Note that the hopping function was not enabled for this test as it is not possible to distinguish the between peaks for some modulation schemes therefore the test was performed using two traces. Trace 1 was performed on CH39 and trace 2 was performed on the upper adjacent channel.

2.2.5 Environmental Conditions

Ambient Temperature 23.8 - 26.6 °C
Relative Humidity 37.3 - 41.5 %

2.2.6 Test Results

Bluetooth BDR/EDR - iPA

Modulation	Channel Separation (MHz)
GFSK	1.004
$\pi/4$ DQPSK	1.000
8-DPSK	0.996

Table 9



Product Service

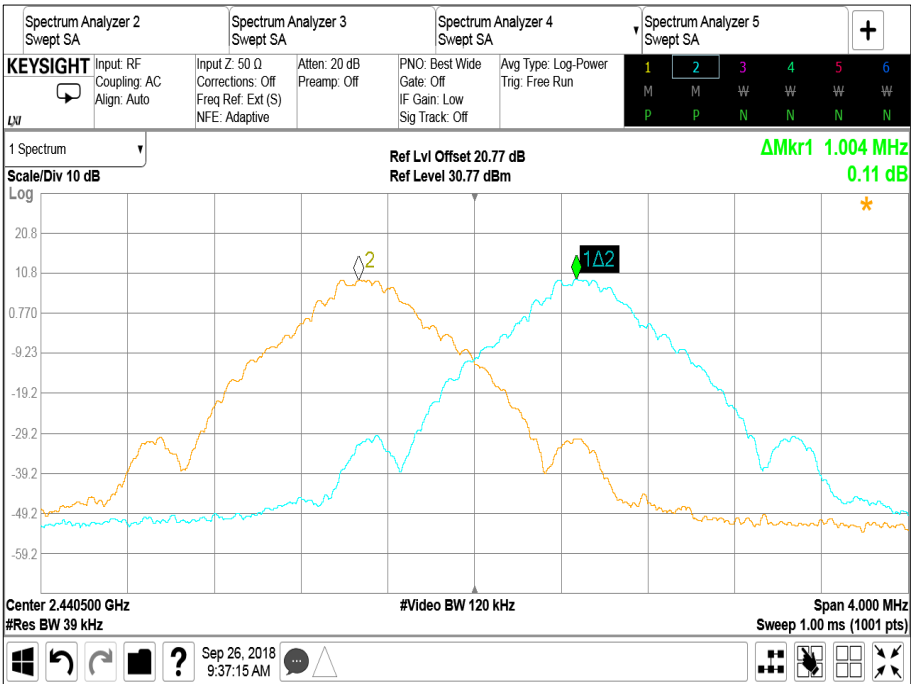


Figure 11 - GFSK

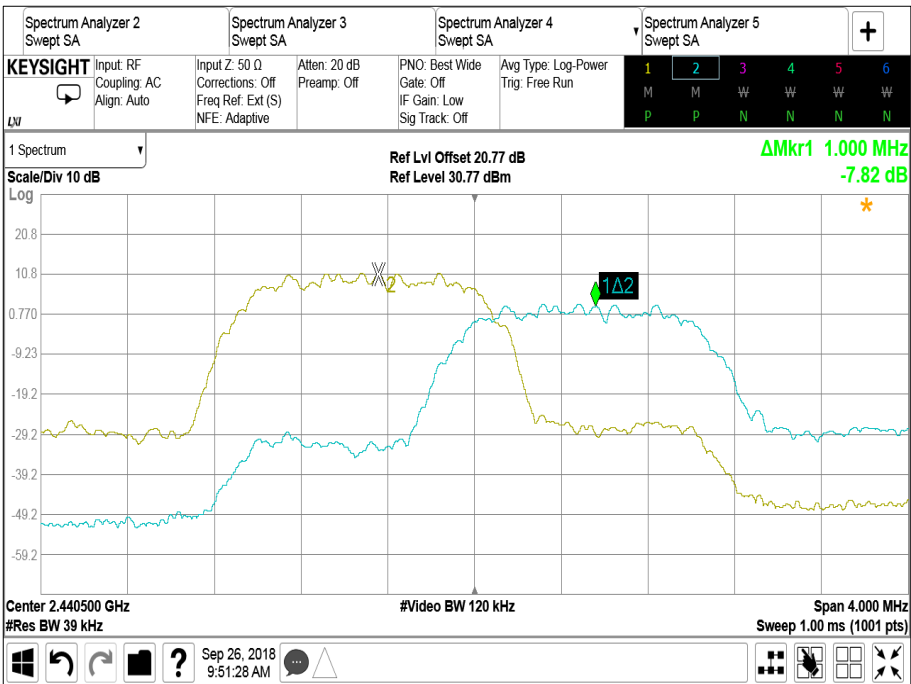


Figure 12 - $\pi/4$ DQPSK

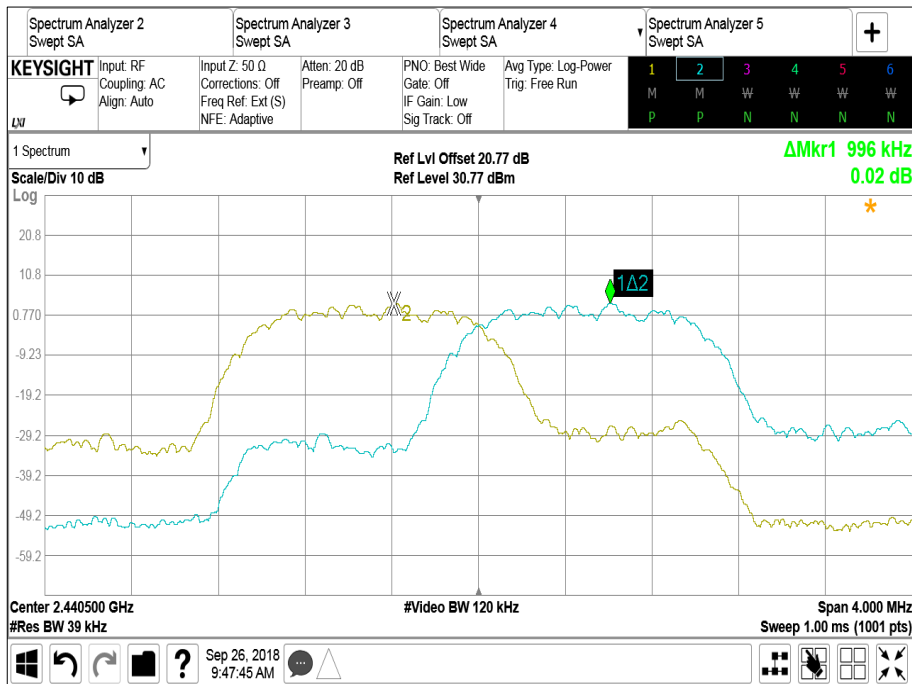


Figure 13 - 8-DPSK

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125 W.

Industry Canada RSS-247, Limit Clause 5.1 (b)

FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.



Bluetooth EDR - ePA

Modulation	Channel Separation (MHz)
$\pi/4$ DQPSK	1.000
8-DPSK	0.996

Table 10

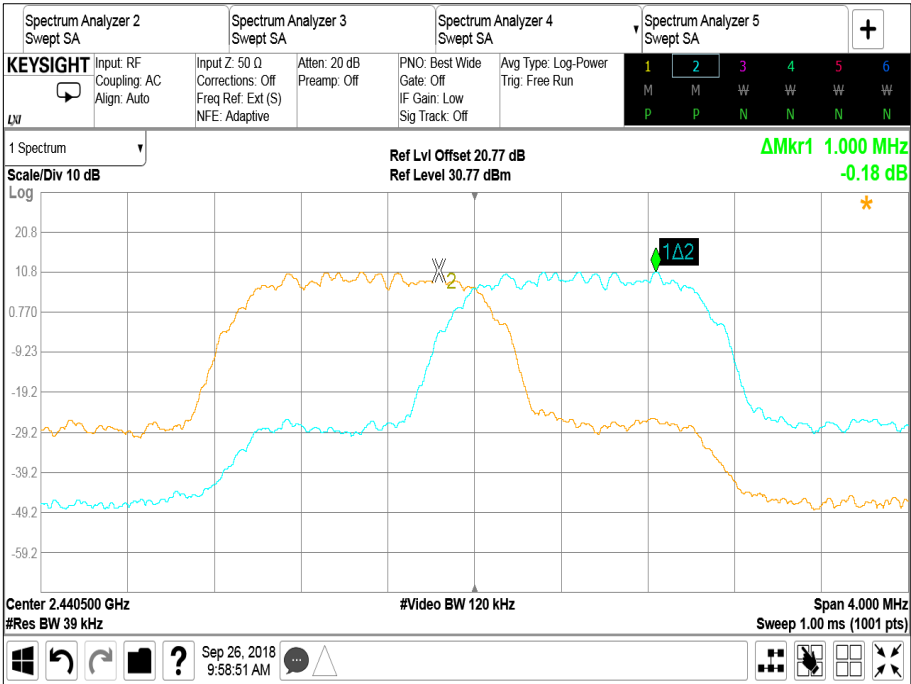


Figure 14 - $\pi/4$ DQPSK



Product Service

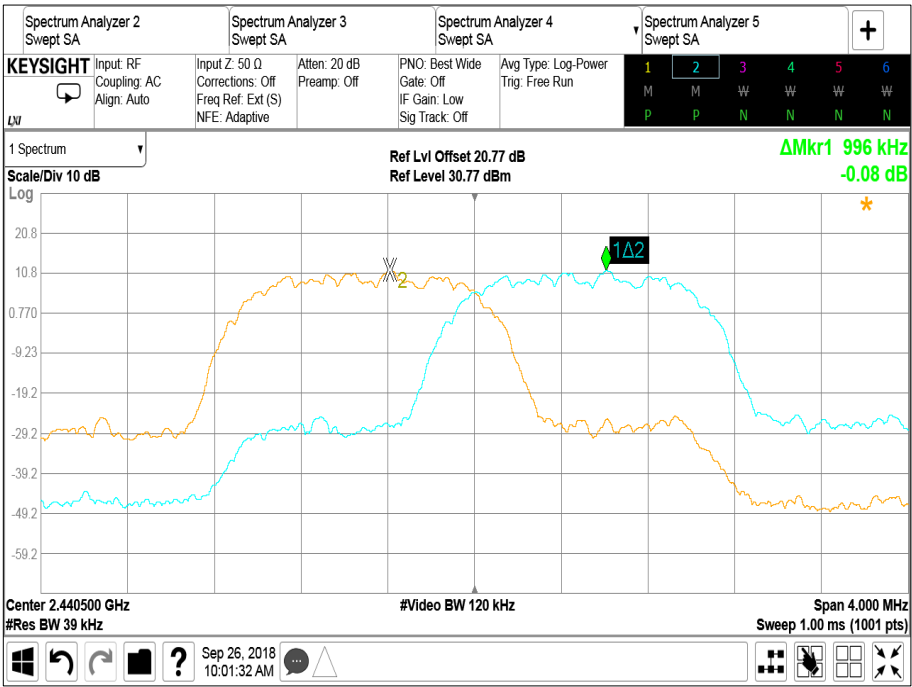


Figure 15 - 8-DPSK



FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125 W.

Industry Canada RSS-247, Limit Clause 5.1 (b)

FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 11



2.3 Frequency Hopping Systems - Number of Hopping Channels

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
Industry Canada RSS-247, Clause 5.1

2.3.2 Equipment Under Test and Modification State

A1932, S/N: C02X5004JL9H - Modification State 0

2.3.3 Date of Test

27-September-2018

2.3.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.3.

2.3.5 Environmental Conditions

Ambient Temperature 26.7 °C
Relative Humidity 44.5 - 44.7 %

2.3.6 Test Results

Bluetooth BDR/EDR - iPA

Number of Hopping Channels: 79

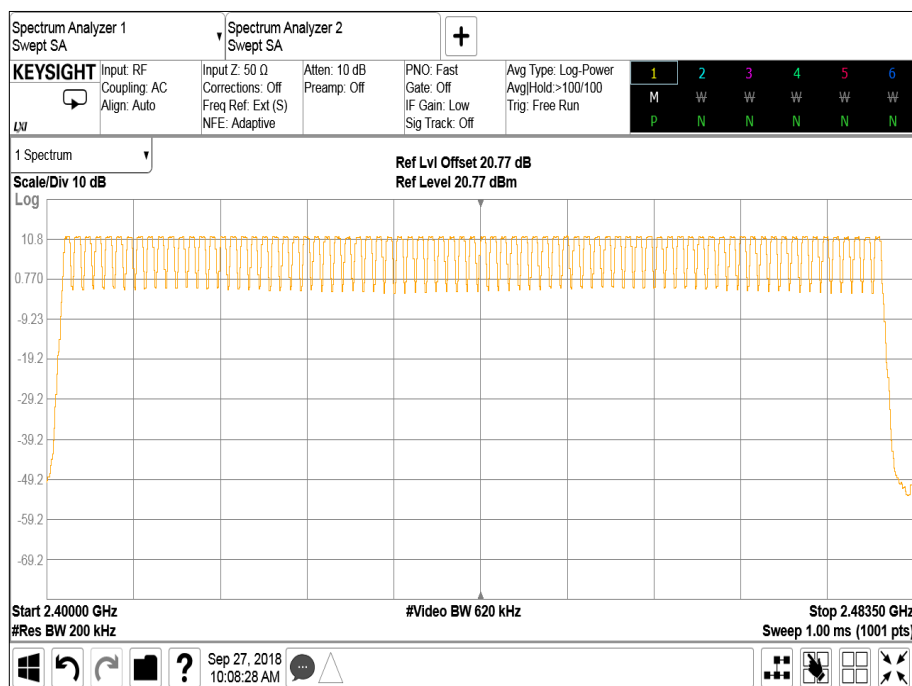


Figure 16 - Measurement Frequency Range: DH5



Product Service

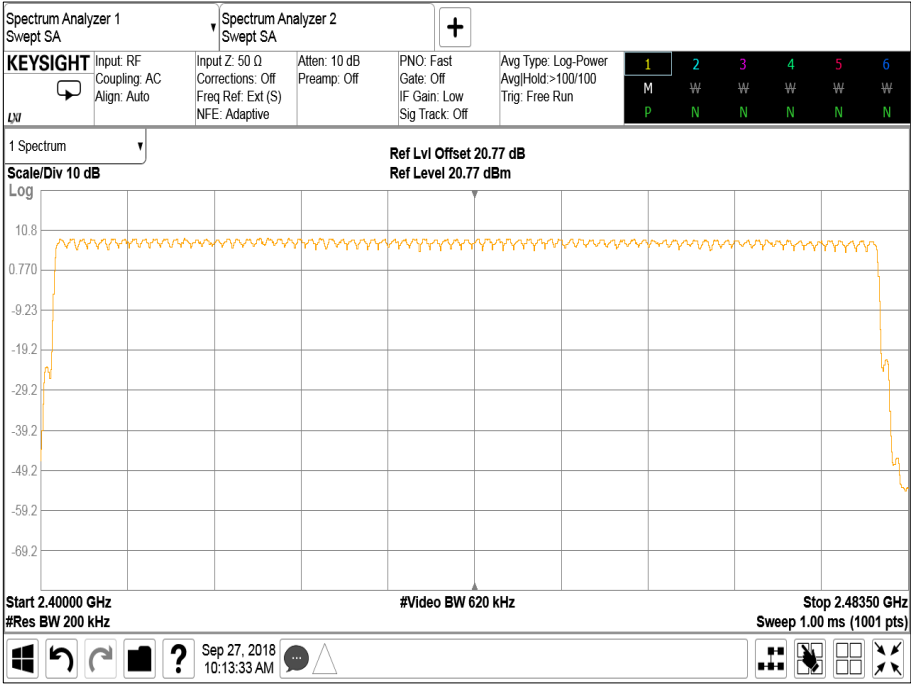


Figure 17 - Measurement Frequency Range: 2DH5

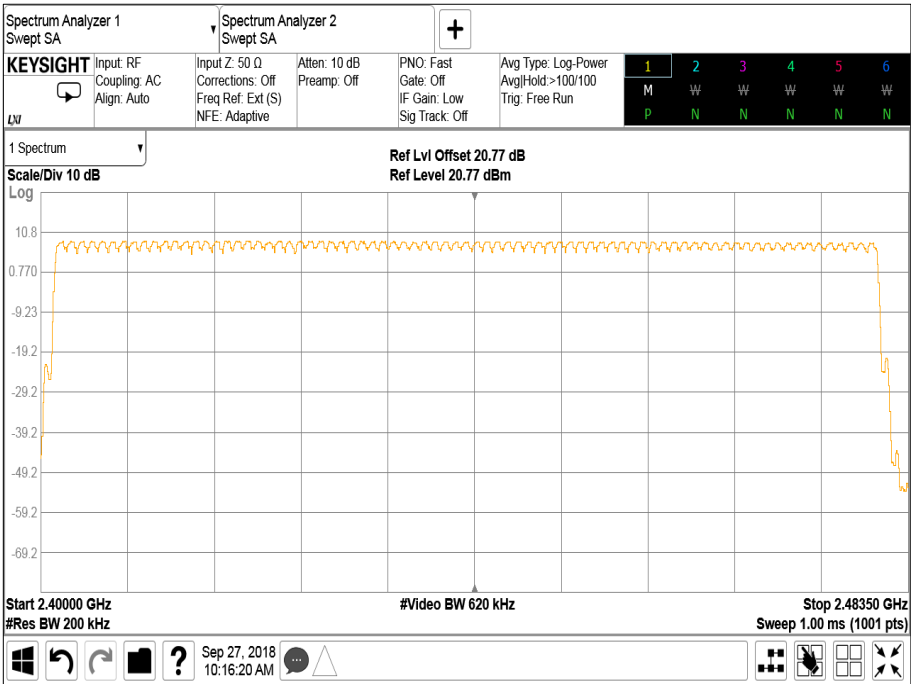


Figure 18 - Measurement Frequency Range: 3DH5



Product Service

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)

≥ 15 channels

Industry Canada RSS-247, Limit Clause 5.1 (d)

FHSSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.



Product Service

Bluetooth EDR - ePA

Number of Hopping Channels: 79

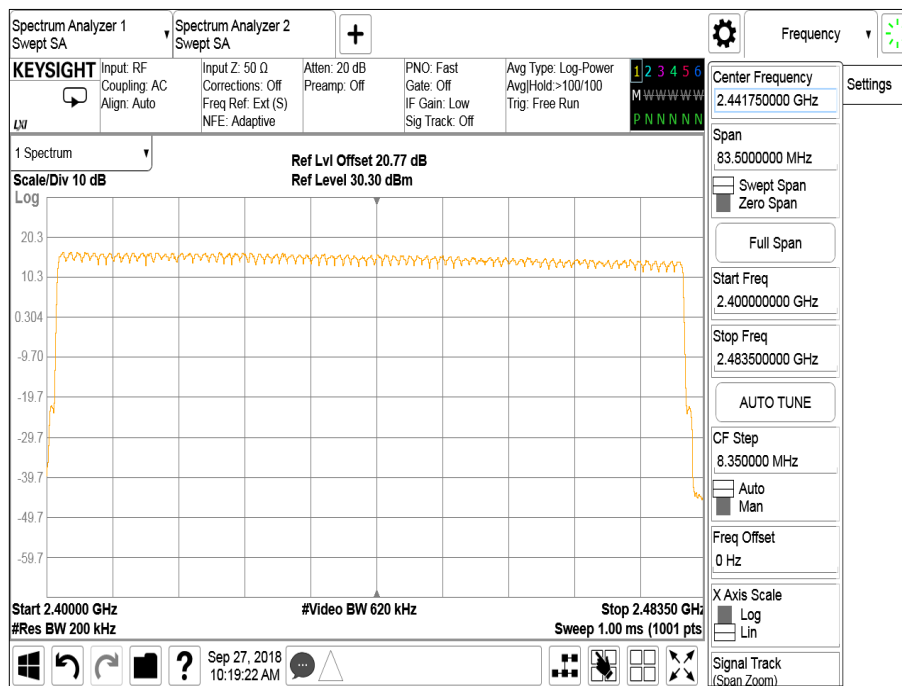


Figure 19 - Measurement Frequency Range: 2DH5

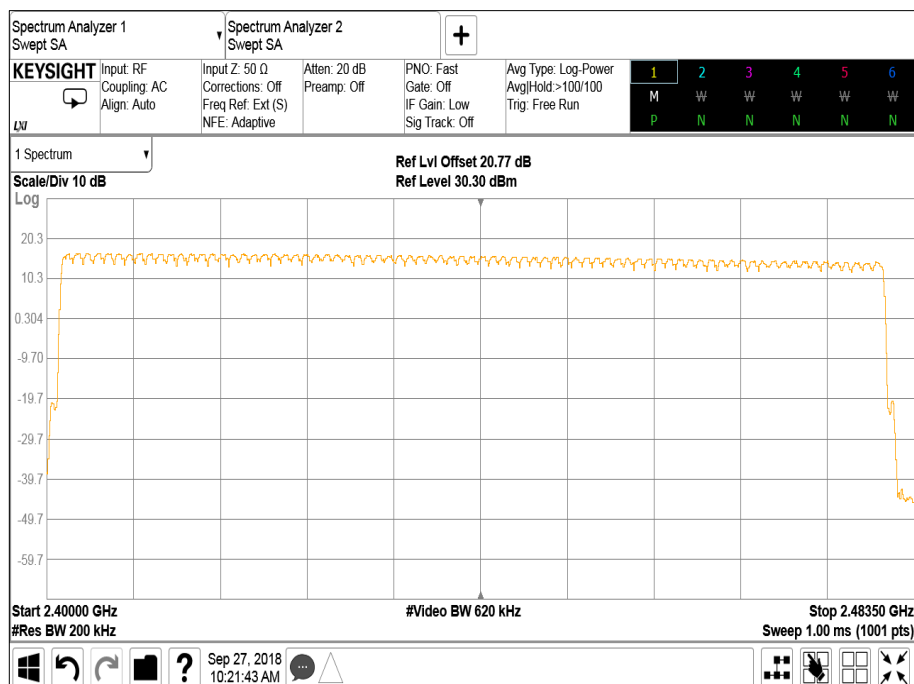


Figure 20 - Measurement Frequency Range: 3DH5



FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)

≥ 15 channels

Industry Canada RSS-247, Limit Clause 5.1 (d)

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 12



2.4 Frequency Hopping Systems - 20 dB Bandwidth

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
Industry Canada RSS-247, Clause 5.1

2.4.2 Equipment Under Test and Modification State

A1932, S/N: C02X5004JL9H - Modification State 0

2.4.3 Date of Test

25-September-2018

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.2

2.4.5 Environmental Conditions

Ambient Temperature 26.6 °C
Relative Humidity 27.6 - 27.7 %

2.4.6 Test Results

Bluetooth BDR/EDR - iPA

Frequency (MHz)	20 dB Bandwidth (kHz)		
	GFSK	$\pi/4$ DQPSK	8-DPSK
2402	924.6	1391	1376
2441	923.6	1384	1371
2480	925.1	1384	1373

Table 13



Product Service

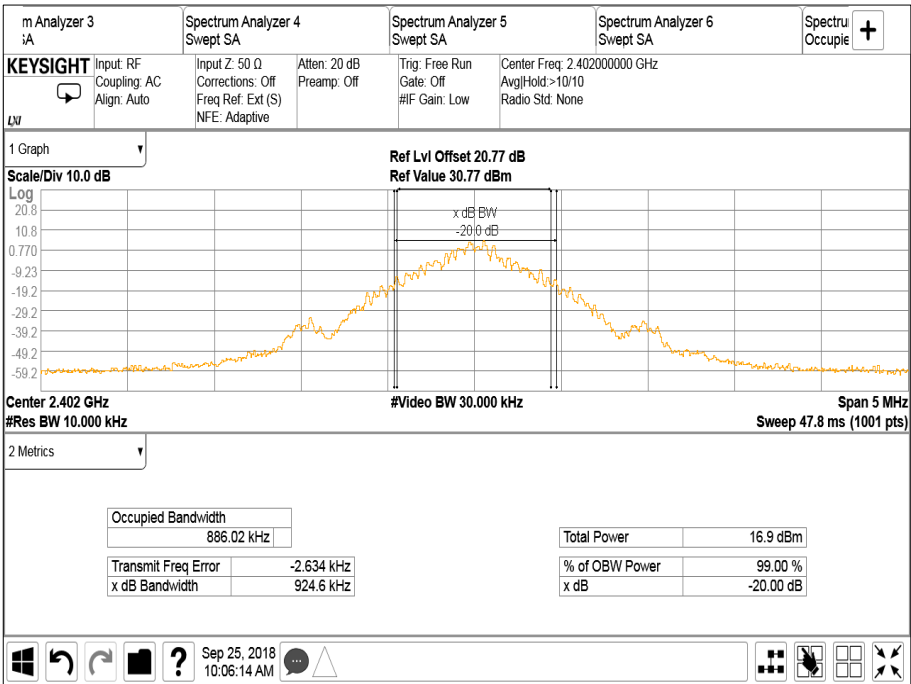


Figure 21 – 2402 MHz - GFSK

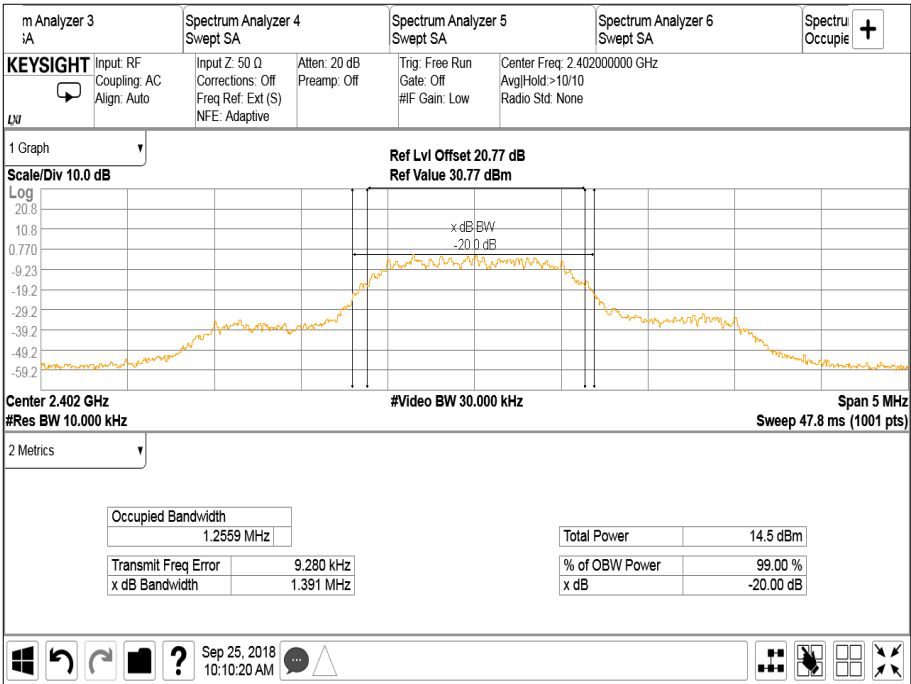


Figure 22 – 2402 MHz - $\pi/4$ DQPSK



Product Service

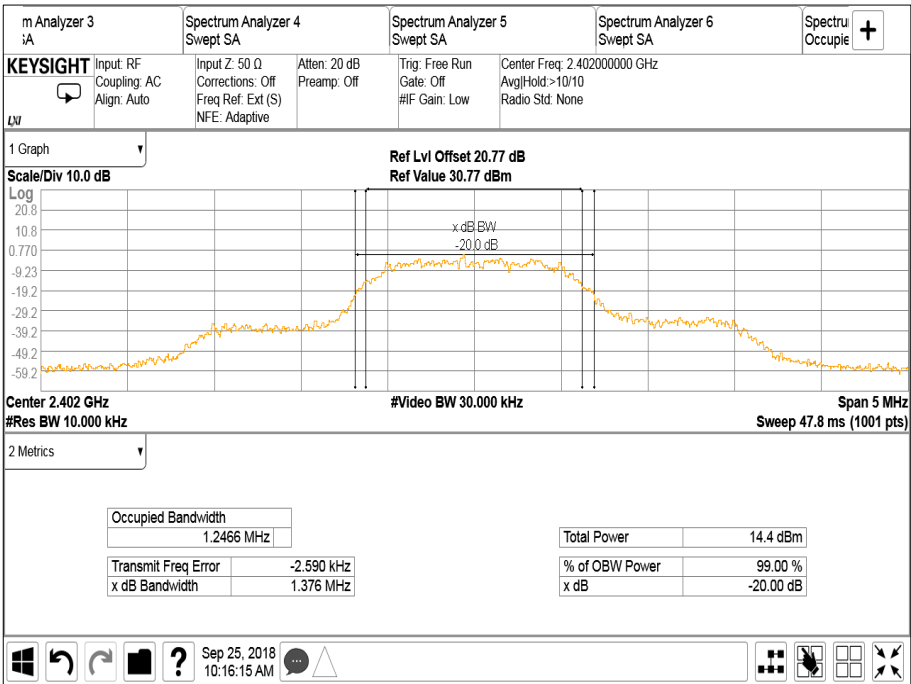


Figure 23 - 2402 MHz - 8-DPSK

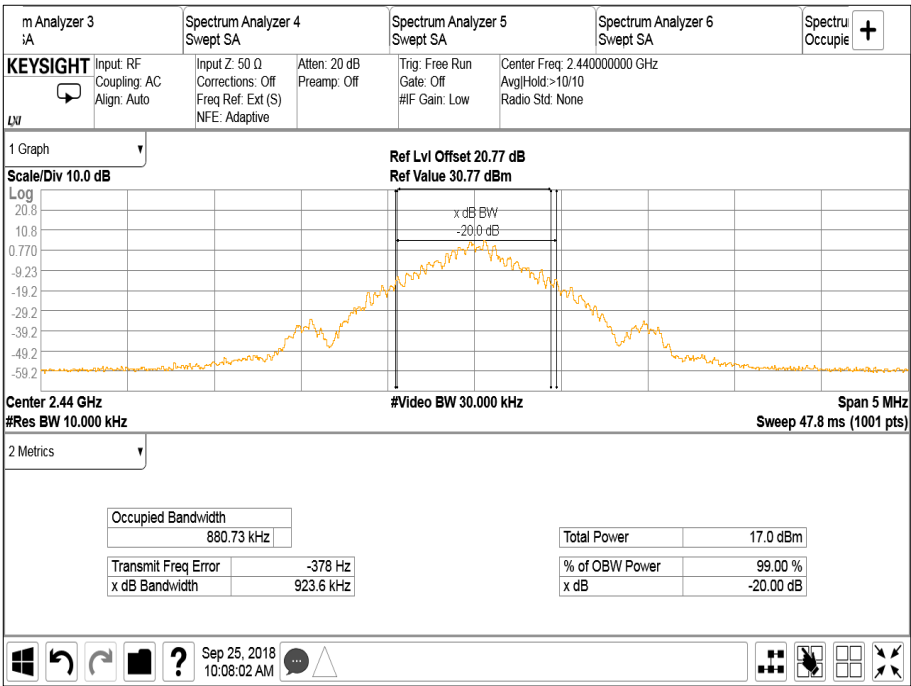


Figure 24 – 2441 MHz - GFSK



Product Service

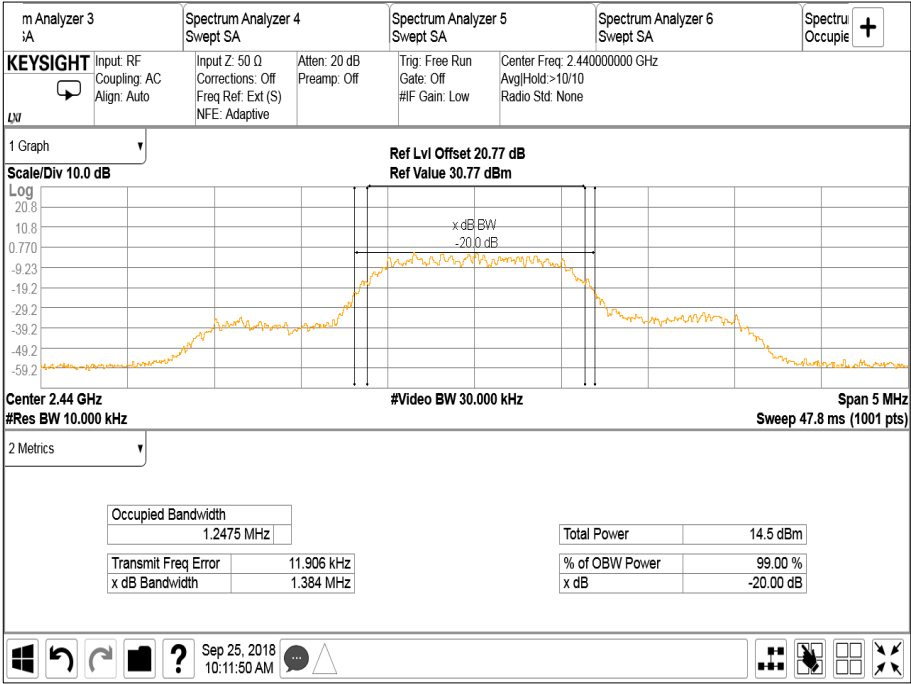


Figure 25 – 2441 MHz - $\pi/4$ DQPSK

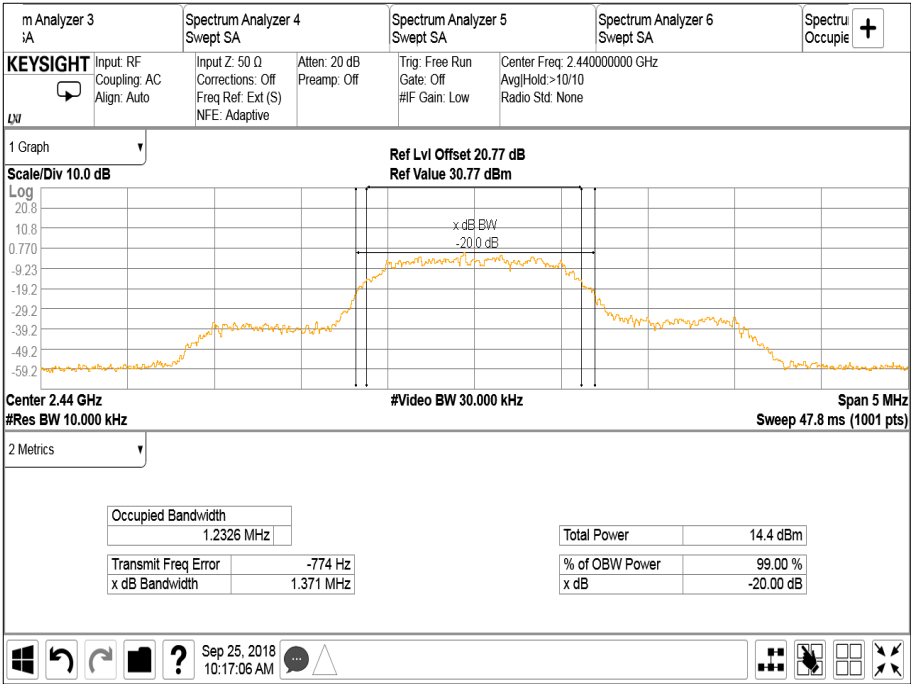


Figure 26 - 2441 MHz - 8-DPSK

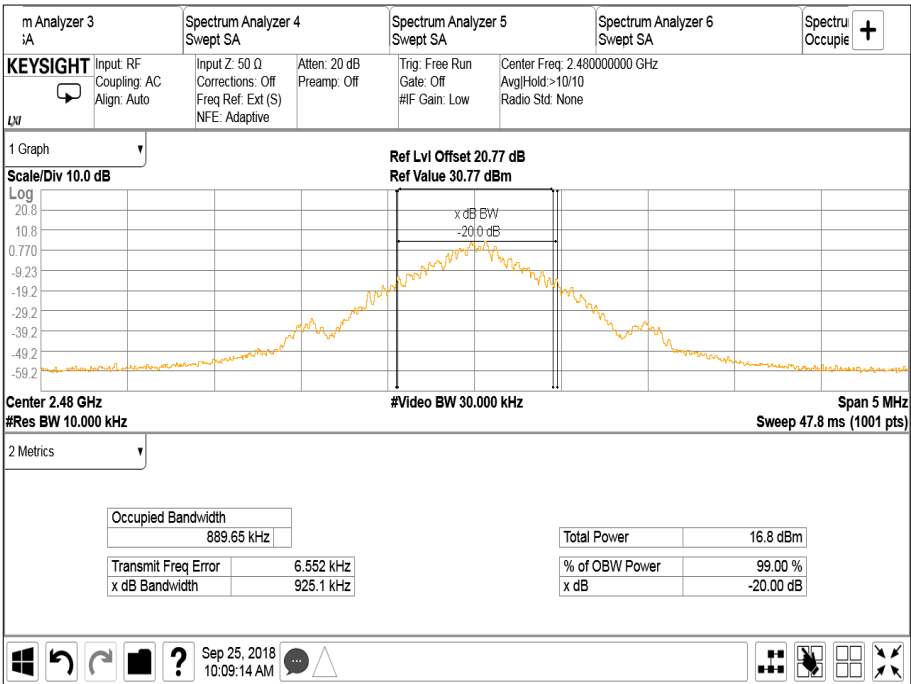


Figure 27 – 2480 MHz - GFSK

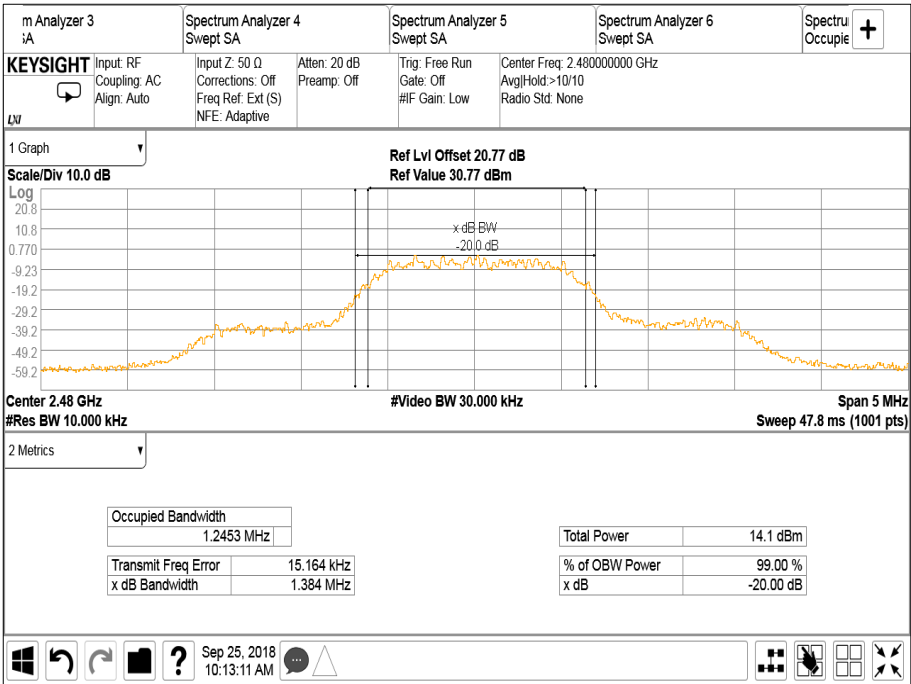


Figure 28 – 2480 MHz - $\pi/4$ DQPSK



Product Service

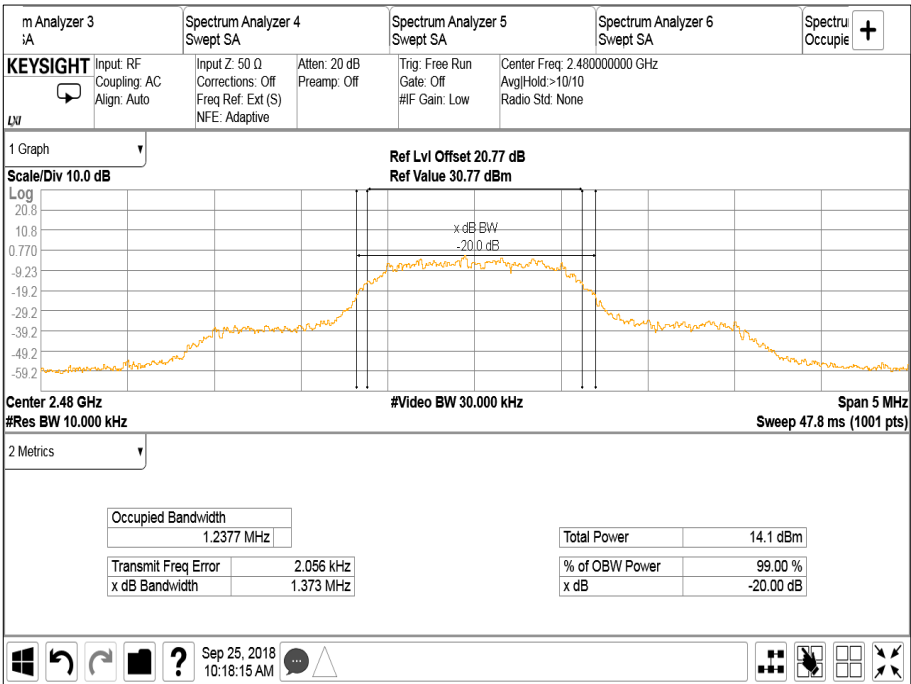


Figure 29 - 2480 MHz - 8-DPSK



Product Service

Bluetooth EDR - ePA

Frequency (MHz)	20 dB Bandwidth (kHz)	
	$\pi/4$ DQPSK	8-DPSK
2402	1374	1363
2441	1342	1349
2480	1341	1369

Table 14

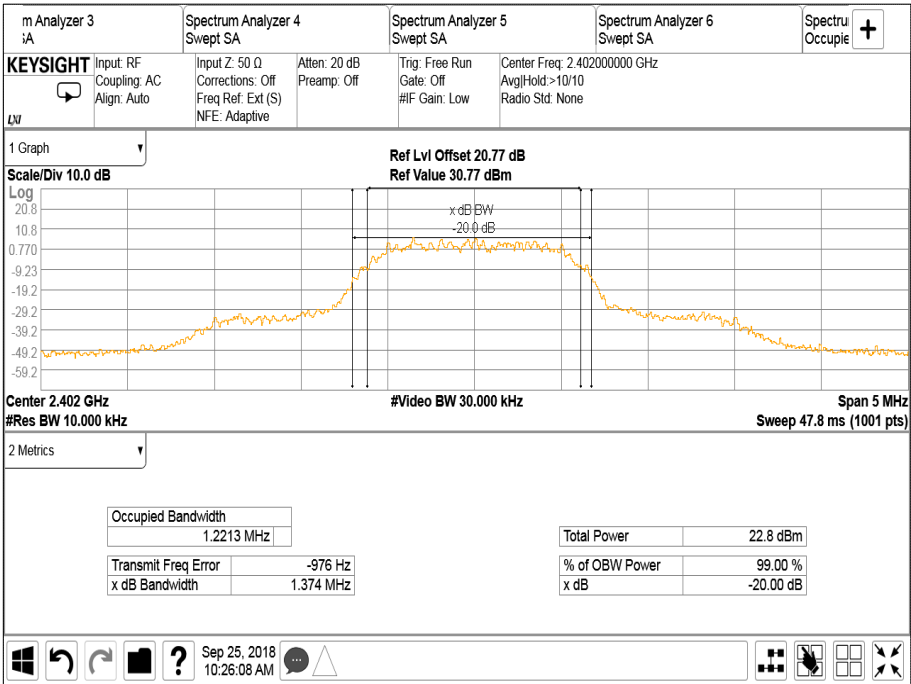


Figure 30 – 2402 MHz - $\pi/4$ DQPSK



Product Service

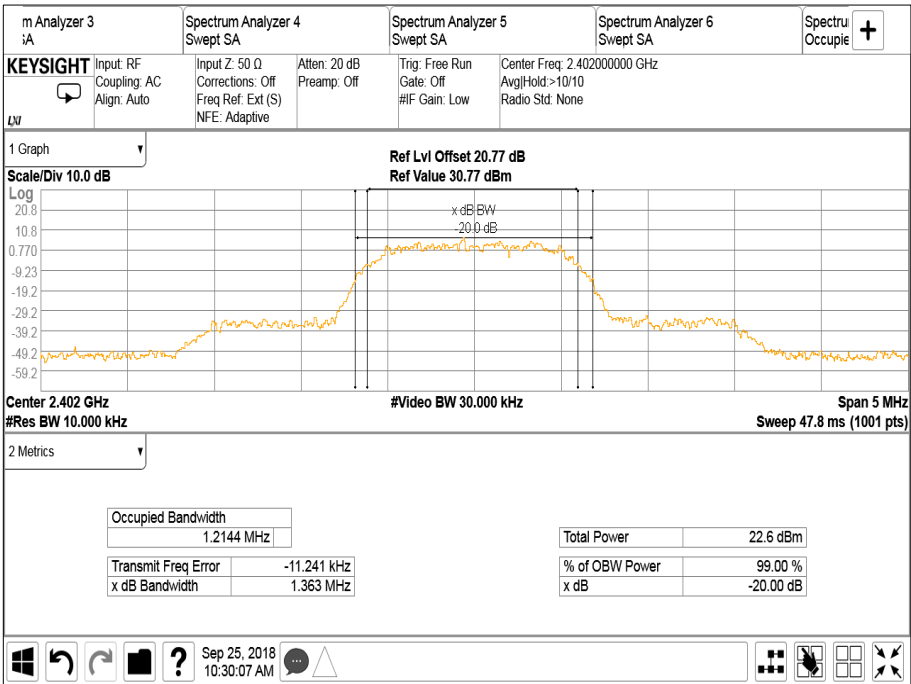


Figure 31 - 2402 MHz - 8-DPSK

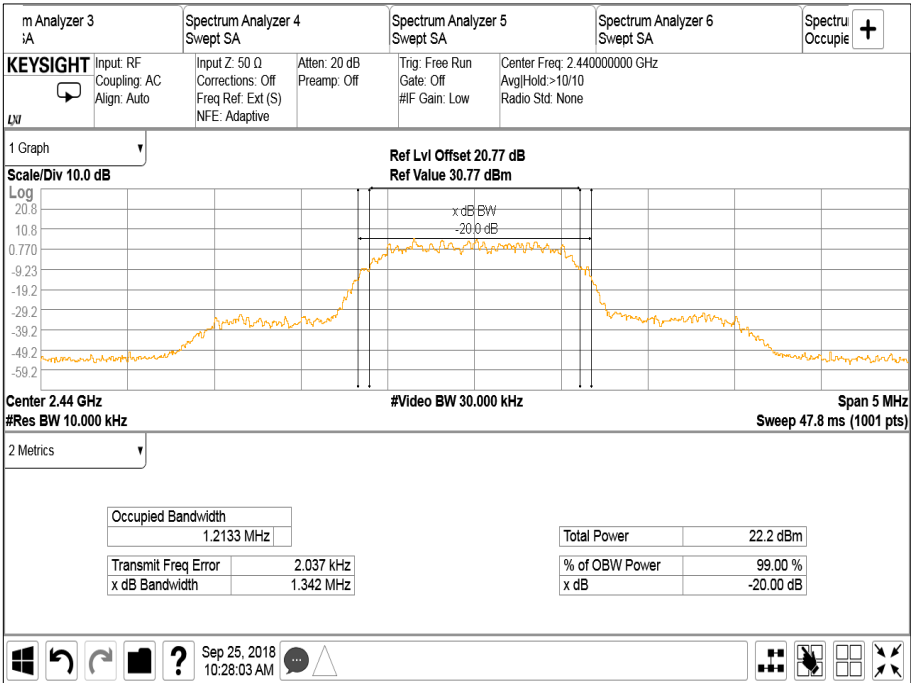


Figure 32 - 2441 MHz - $\pi/4$ DQPSK



Product Service

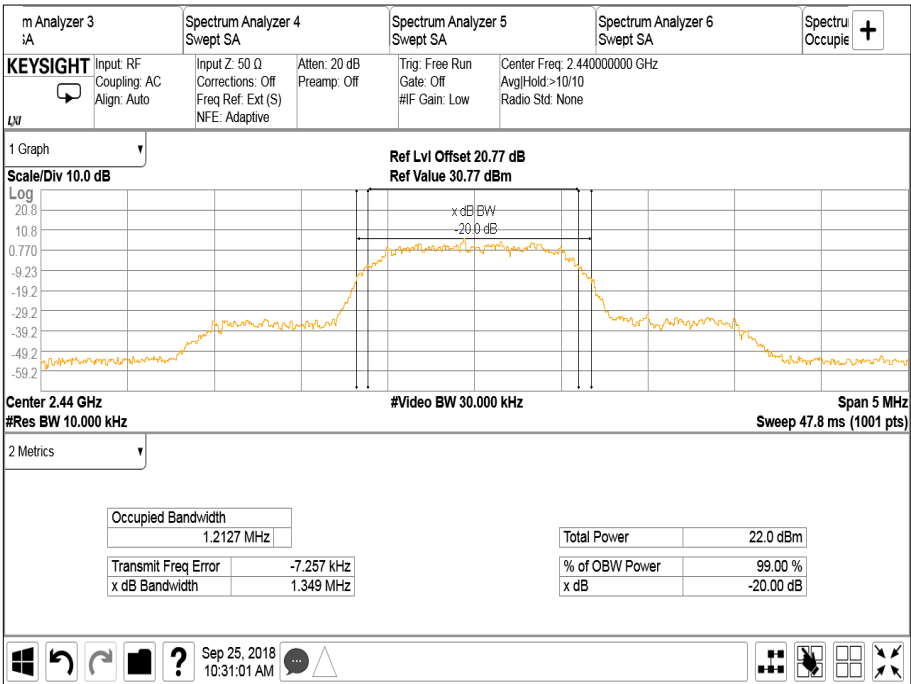


Figure 33 - 2441 MHz - 8-DPSK

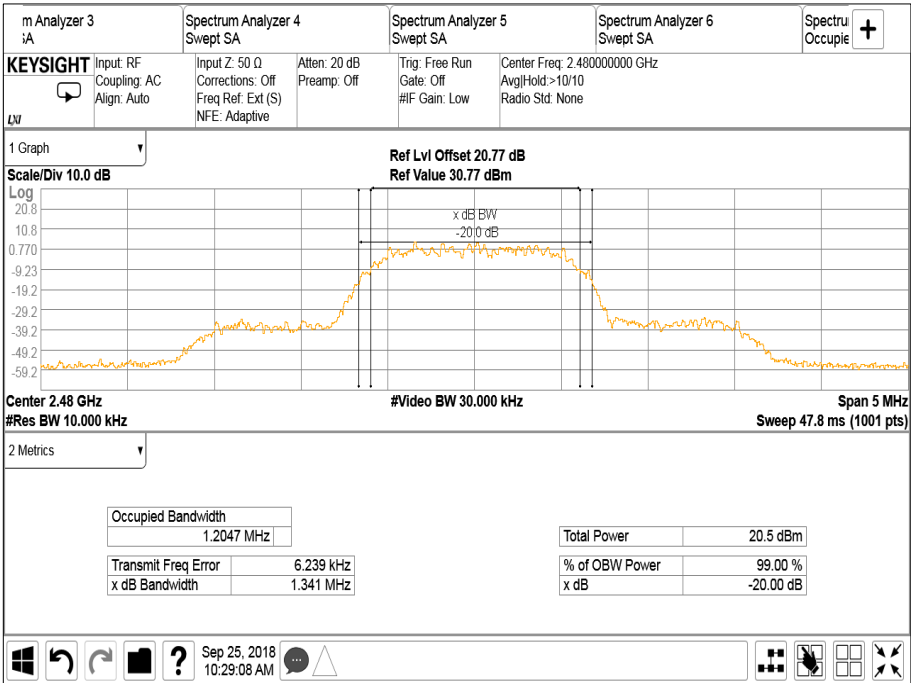


Figure 34 - 2480 MHz - $\pi/4$ DQPSK

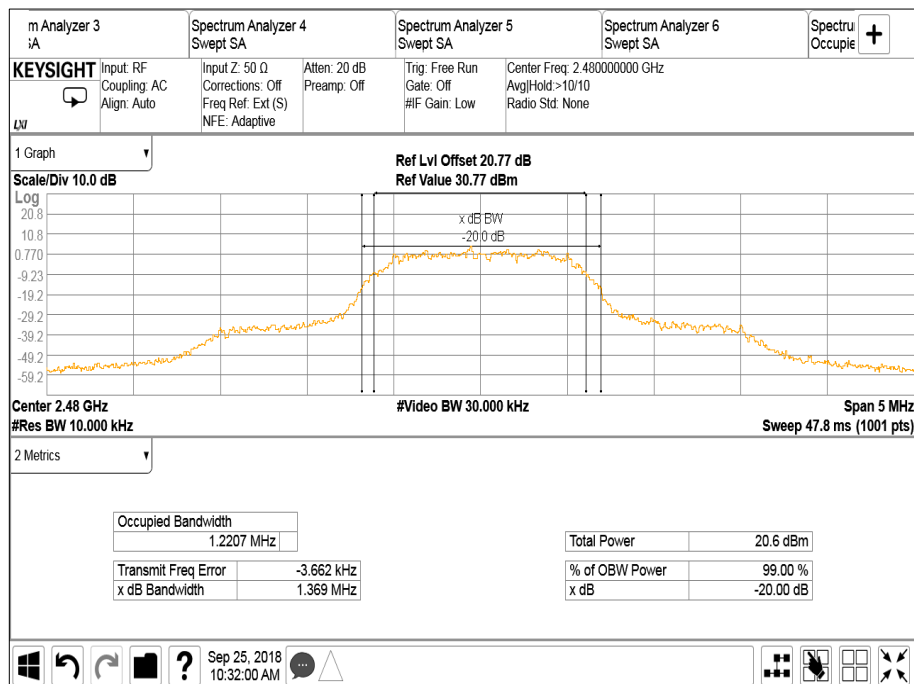


Figure 35 - 2480 MHz - 8-DPSK

2.4.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 15



2.5 Authorised Band Edges

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d)
Industry Canada RSS-247, Clause 5.5

2.5.2 Equipment Under Test and Modification State

A1932, S/N: C02WG001JV8M - Modification State 0

2.5.3 Date of Test

28-September-2018

2.5.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.10.4.

Note: 2483.5 MHz is both an Authorised Band Edge and a Restricted Band Edge. Of the two limits, the Restricted Band Edge is the most stringent and therefore demonstrates compliance with the 20 dBc Authorised Band Edge requirement.

2.5.5 Environmental Conditions

Ambient Temperature 22.8 °C
Relative Humidity 41.1 - 53.3 %

2.5.6 Test Results

Bluetooth BDR/EDR - iPA

Mode	Modulation	Packet Type	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
Static	GFSK	DH5	2402	2400.0	-61.51
Static	$\pi/4$ DQPSK	2DH5	2402	2400.0	-43.76
Static	8-DPSK	3DH5	2402	2400.0	-44.06
Hopping	GFSK	DH5	2402	2400.0	-62.03
Hopping	$\pi/4$ DQPSK	2DH5	2402	2400.0	-59.21
Hopping	8-DPSK	3DH5	2402	2400.0	-57.40

Table 16

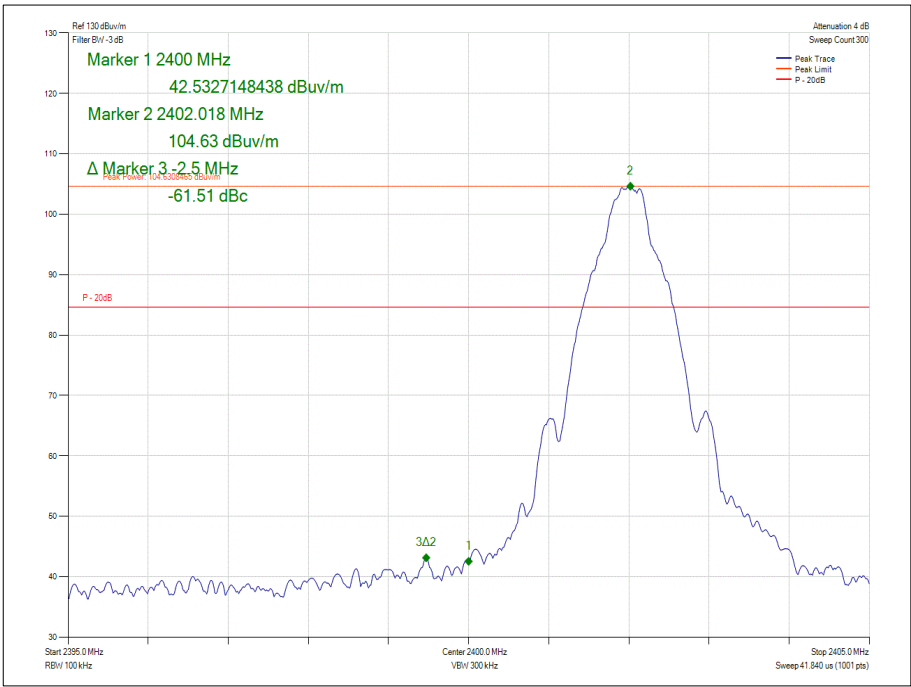


Figure 36 - Static - GFSK/DH5 - 2402 MHz - Measured Frequency 2400.0 MHz

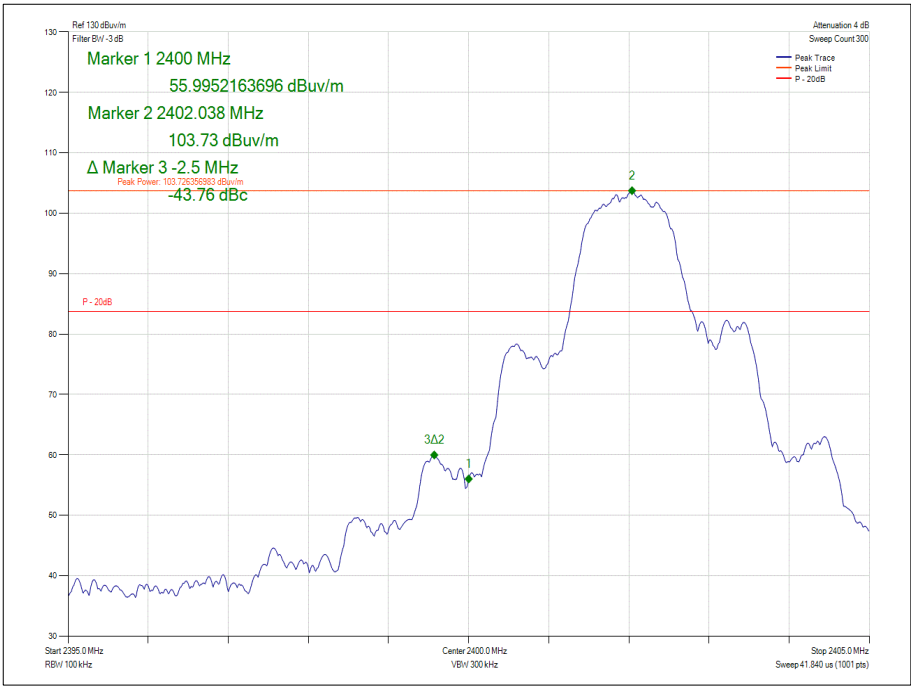


Figure 37 - Static - $\pi/4$ DQPSK/2DH5 - 2402 MHz - Measured Frequency 2400.0 MHz

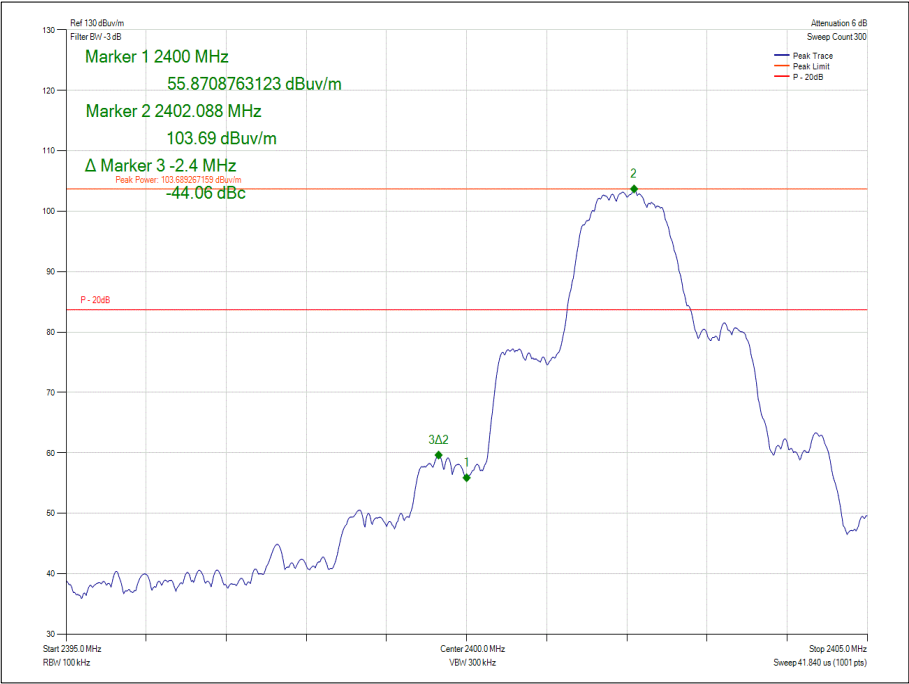


Figure 38 - Static - 8-DPSK/3DH5 - 2402 MHz - Measured Frequency 2400.0 MHz

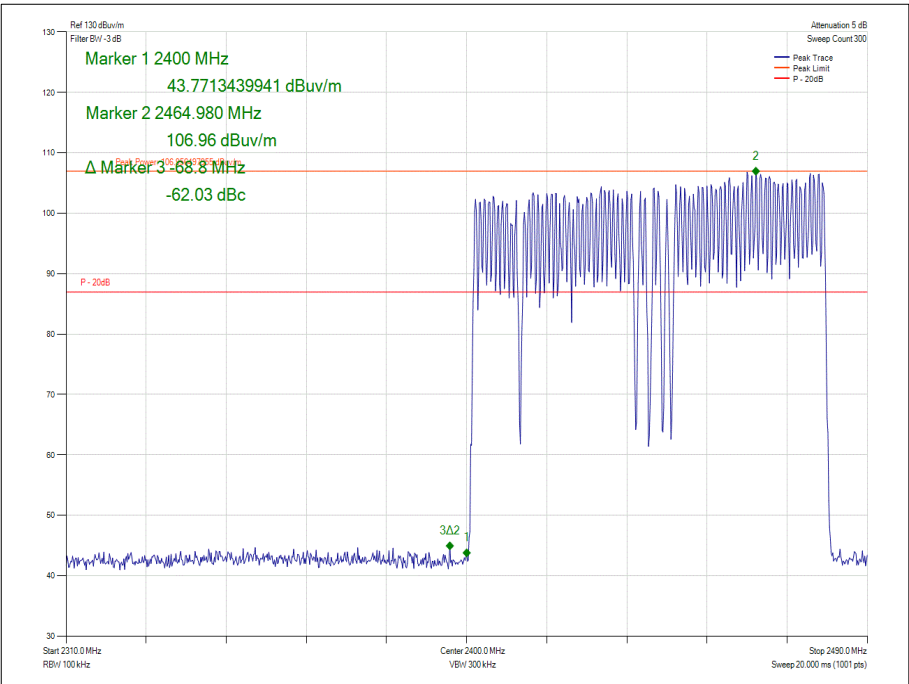


Figure 39 - Hopping - GFSK/DH5 - Measured Frequency 2400.0 MHz

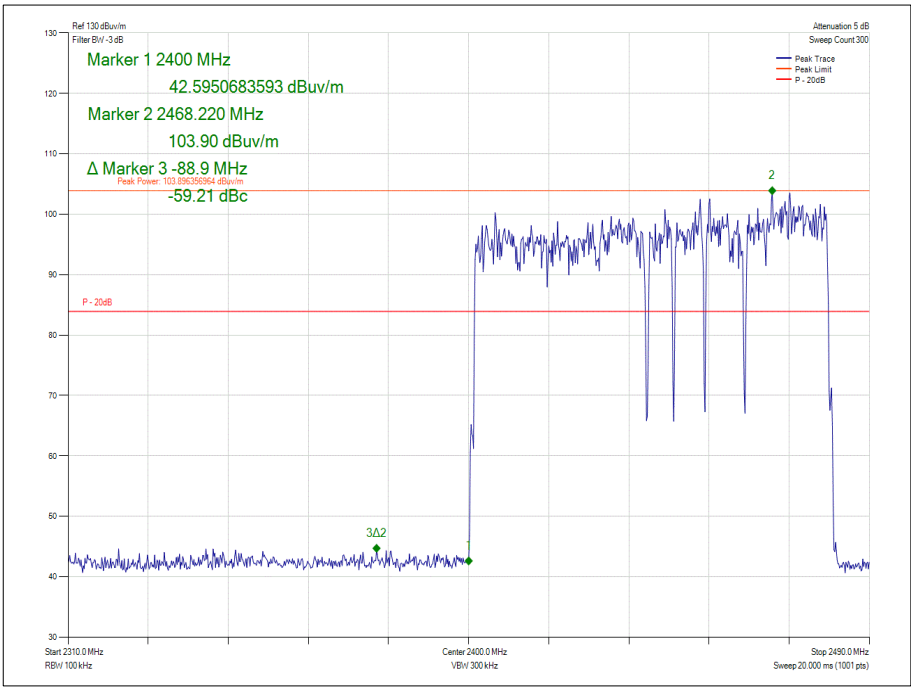


Figure 40 - Hopping - $\pi/4$ DQPSK/2DH5 - Measured Frequency 2400.0 MHz

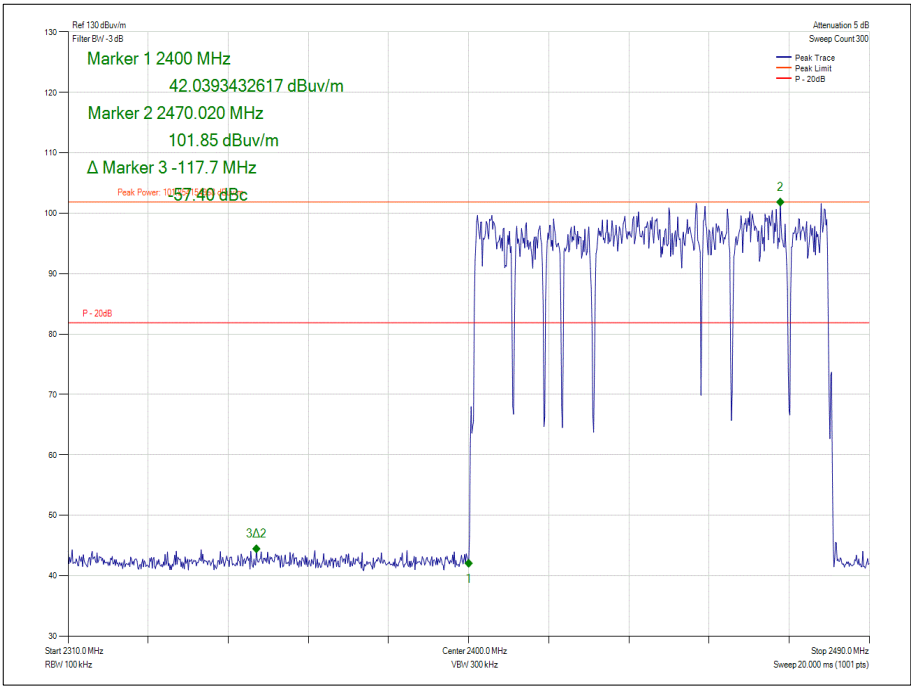


Figure 41 - Hopping - 8-DPSK/3DH5 - Measured Frequency 2400.0 MHz



Product Service

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Bluetooth EDR - ePA

Mode	Modulation	Packet Type	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
Static	$\pi/4$ DQPSK	2DH5	2402	2400.0	-58.68
Static	8-DPSK	3DH5	2402	2400.0	-59.84
Hopping	$\pi/4$ DQPSK	2DH5	2480	2400.0	-65.10
Hopping	8-DPSK	3DH5	2402	2400.0	-65.84

Table 17 - Static - GFSK/ - 2402 MHz - Measured Frequency 2400.0 MHz

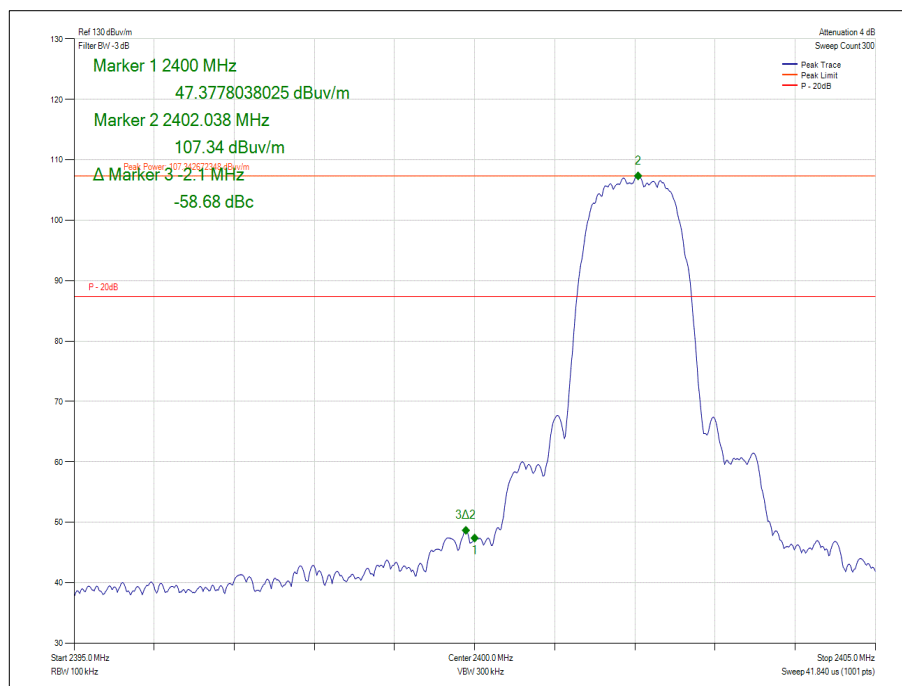


Figure 42 - Static - $\pi/4$ DQPSK/2DH5 - 2402 MHz - Measured Frequency 2400.0 MHz

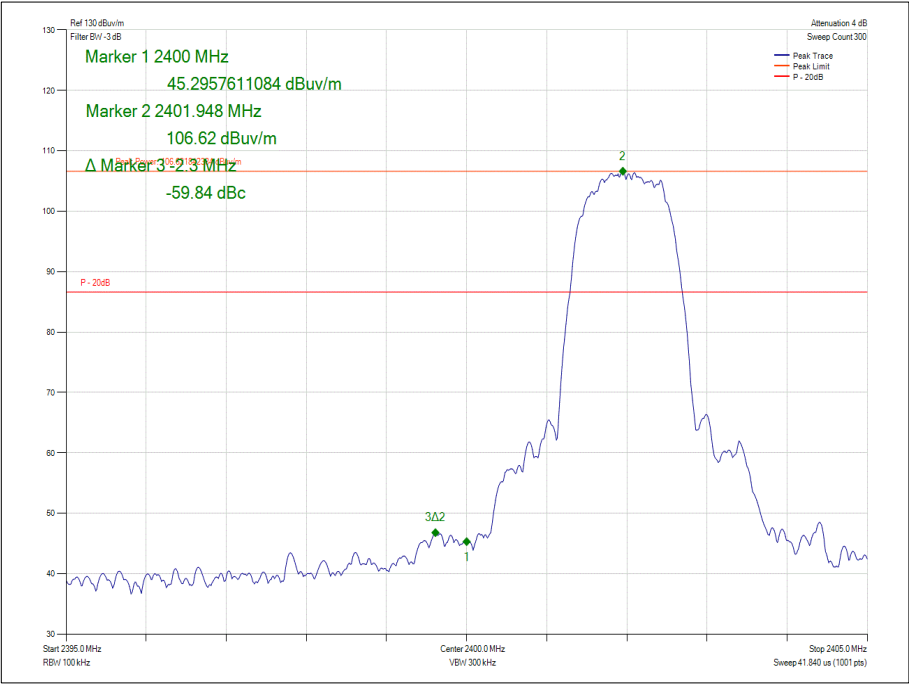


Figure 43 - Static - 8-DPSK/3DH5 - 2402 MHz - Measured Frequency 2400.0 MHz

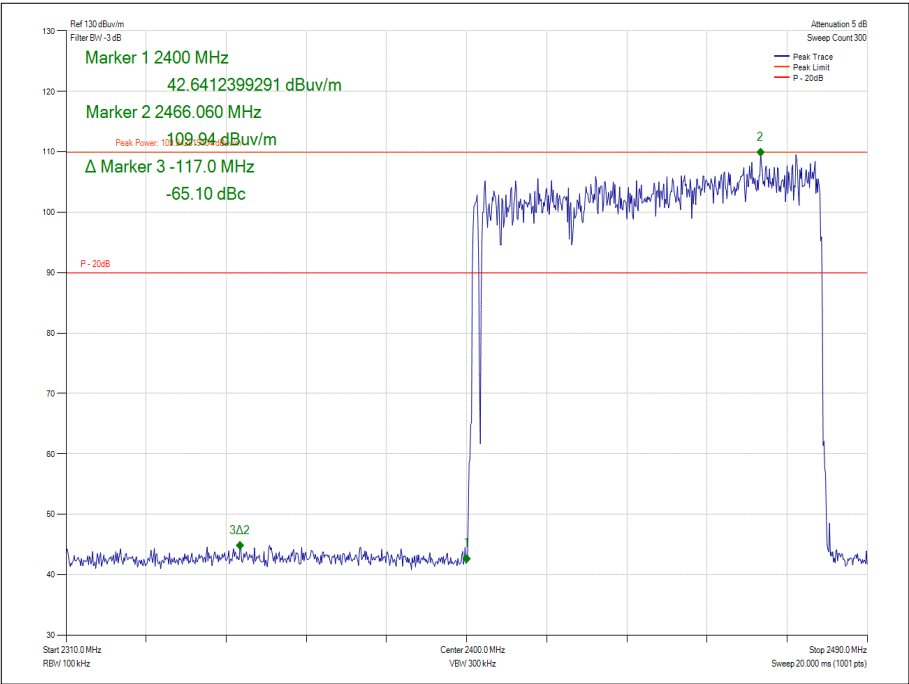


Figure 44 - Hopping - $\pi/4$ DQPSK/2DH5 - Measured Frequency 2400.0 MHz

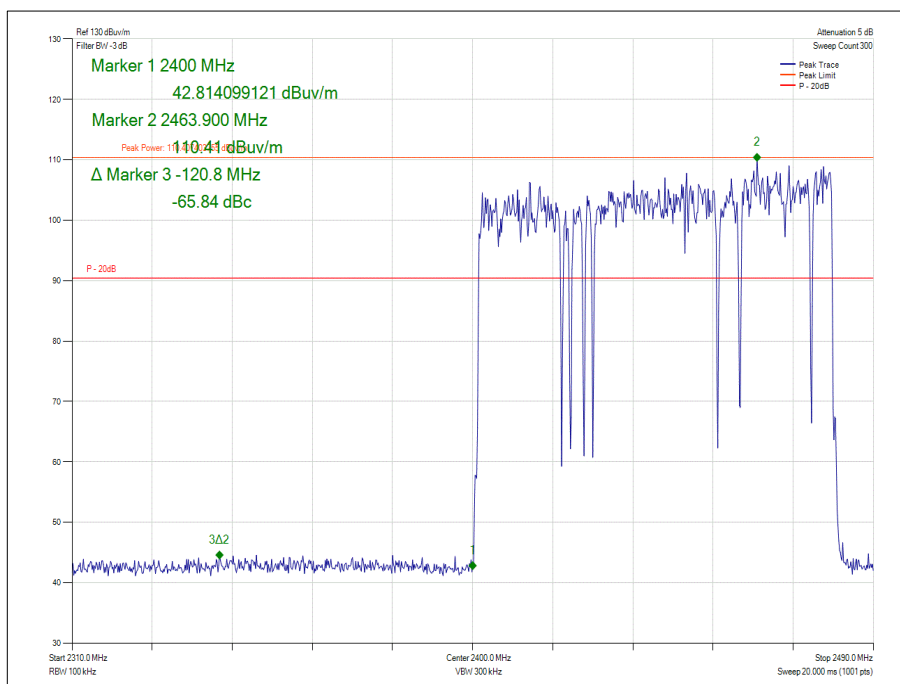


Figure 45 - Hopping - 8-DPSK/3DH5 - Measured Frequency 2400.0 MHz

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.



2.5.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Hygrometer	Rotronic	HP21	4989	12	26-April-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	9-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Cable	Rosenberger	LU7-071-1000	5104	6	05-Oct-2019
Cable	Rosenberger	LU7-071-2000	4528	-	O/P Mon
Cable	Rosenberger	2303-0 9.0m PNm PNm	4827	12	04-Jan-2019
EMI Receiver	Keysight Technologies	N9038A MXE	4628	12	04-July-2019

Table 18

TU – Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.6 Restricted Band Edges

2.6.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205
Industry Canada RSS-GEN, Clause 8.10

2.6.2 Equipment Under Test and Modification State

A1932, S/N: C02WG001JV8M - Modification State 0

2.6.3 Date of Test

07-September-2018

2.6.4 Test Method

Testing was performed in accordance with ANSI C63.10, clause 6.10.5

The following conversion can be applied to convert from dBμV/m to μV/m:
 $10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$.

2.6.5 Environmental Conditions

Ambient Temperature 22.8 - 22.9 °C
Relative Humidity 41.1 - 53.3 %

2.6.6 Test Results

Bluetooth BDR/EDR - iPA

Mode	Modulation	Packet Type	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Hopping	GFSK	DH5	2402	2390.0	53.66	46.99
Hopping	π/4 DQPSK	2DH5	2402	2390.0	53.04	47.39
Hopping	8-DPSK	3DH5	2402	2390.0	53.49	46.57
Hopping	GFSK	DH5	2480	2483.5	53.42	48.34
Hopping	π/4 DQPSK	2DH5	2480	2483.5	53.12	48.43
Hopping	8-DPSK	3DH5	2480	2483.5	53.55	47.91
Static	GFSK	DH5	2402	2390.0	50.94	49.41
Static	π/4 DQPSK	2DH5	2402	2390.0	51.98	50.09
Static	8-DPSK	3DH5	2402	2390.0	52.28	50.80
Static	GFSK	DH5	2480	2483.5	53.53	50.93
Static	π/4 DQPSK	2DH5	2480	2483.5	53.59	50.95
Static	8-DPSK	3DH5	2480	2483.5	54.2	51.03

Table 19

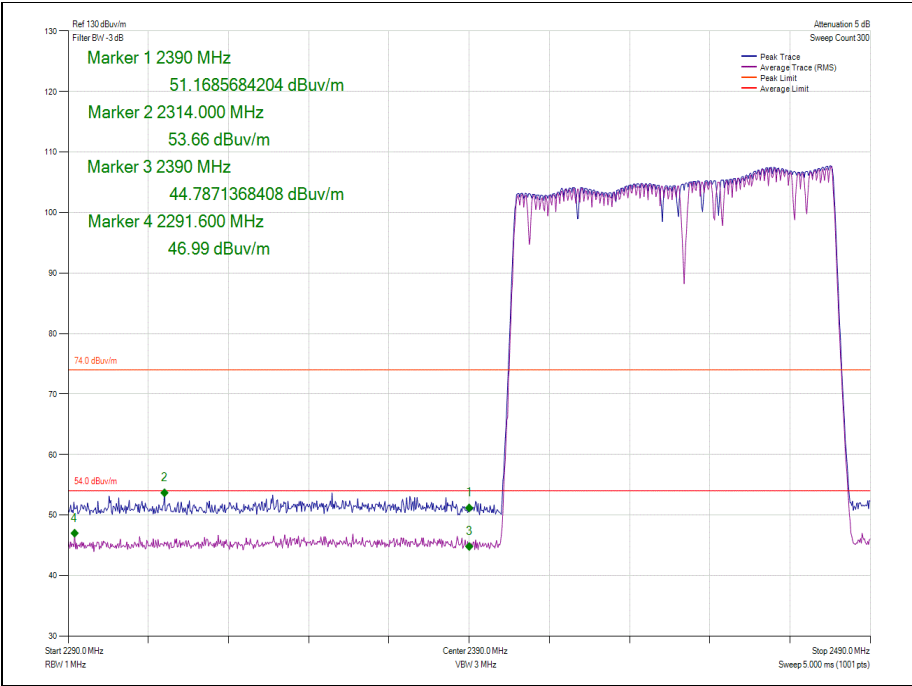


Figure 46 - Hopping - GFSK/DH5 - Measured Frequency 2390.0 MHz

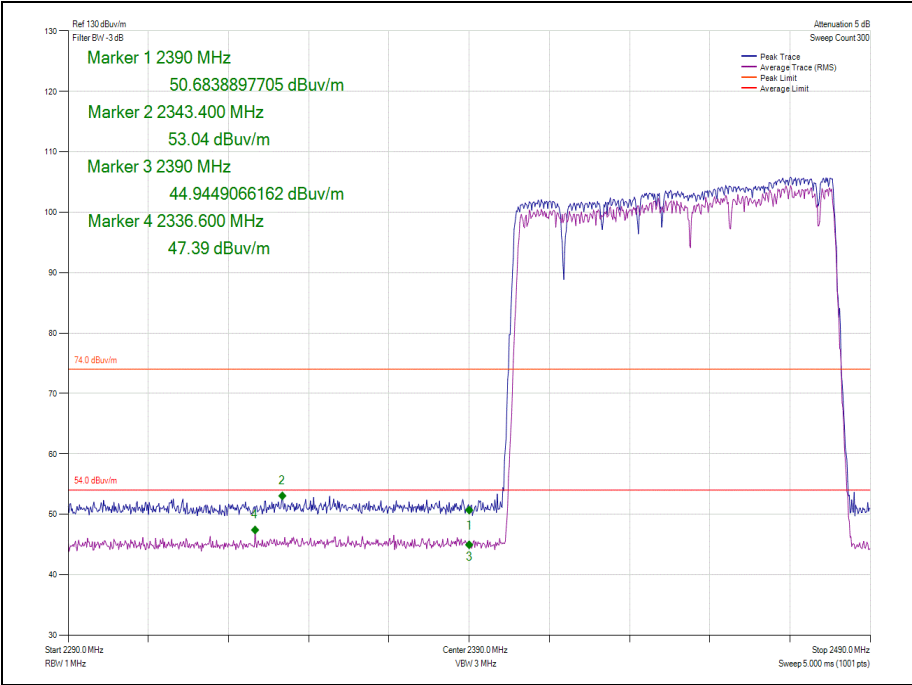


Figure 47- Hopping - $\pi/4$ DQPSK/2DH5 - Measured Frequency 2390.0 MHz

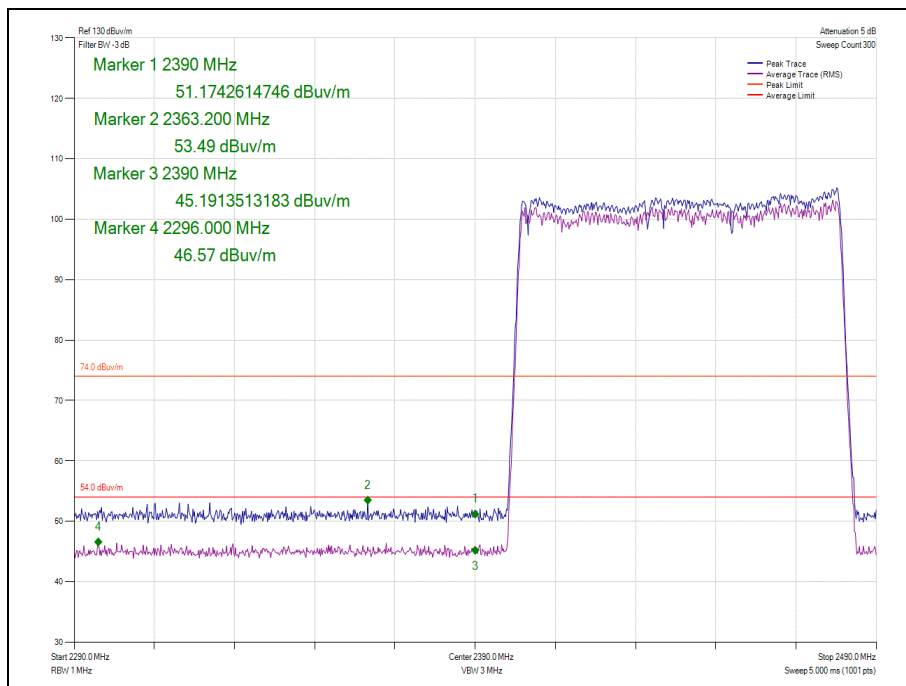


Figure 48- Hopping - 8-DPSK/3DH5 - Measured Frequency 2390.0 MHz

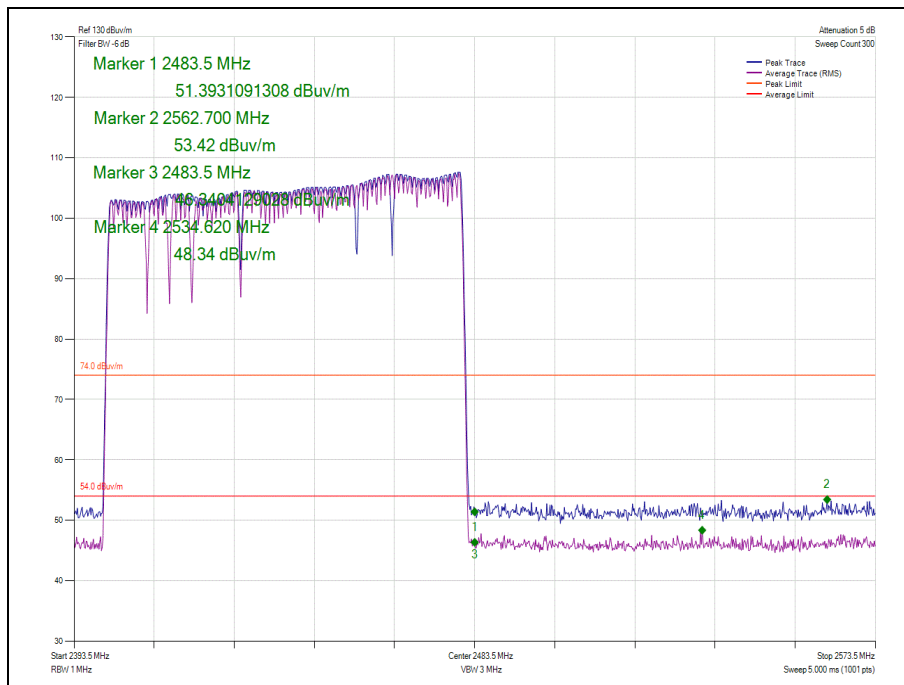


Figure 49 - Hopping - GFSK/DH5 - Measured Frequency 2483.5 MHz

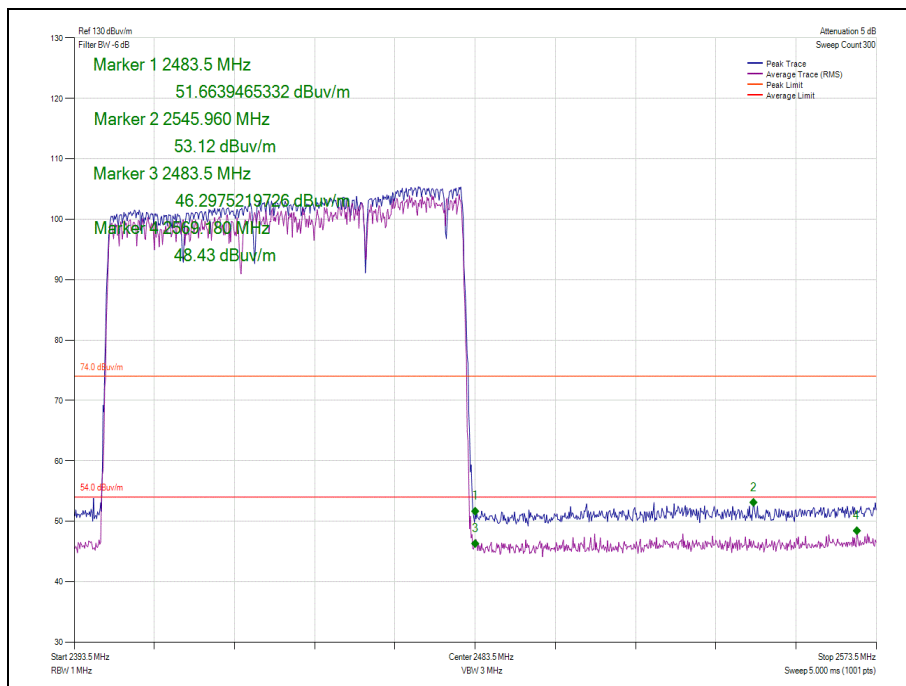


Figure 50- Hopping - $\pi/4$ DQPSK/2DH5 - Measured Frequency 2483.5 MHz



Figure 51- Hopping - 8-DPSK/3DH5 - Measured Frequency 2483.5 MHz

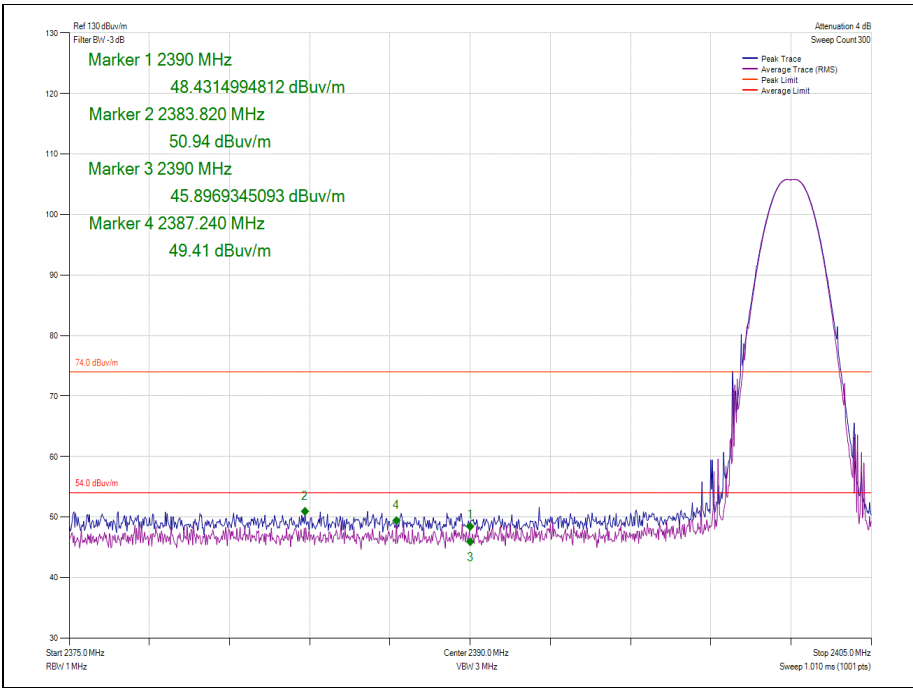


Figure 52 - Static - GFSK/DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

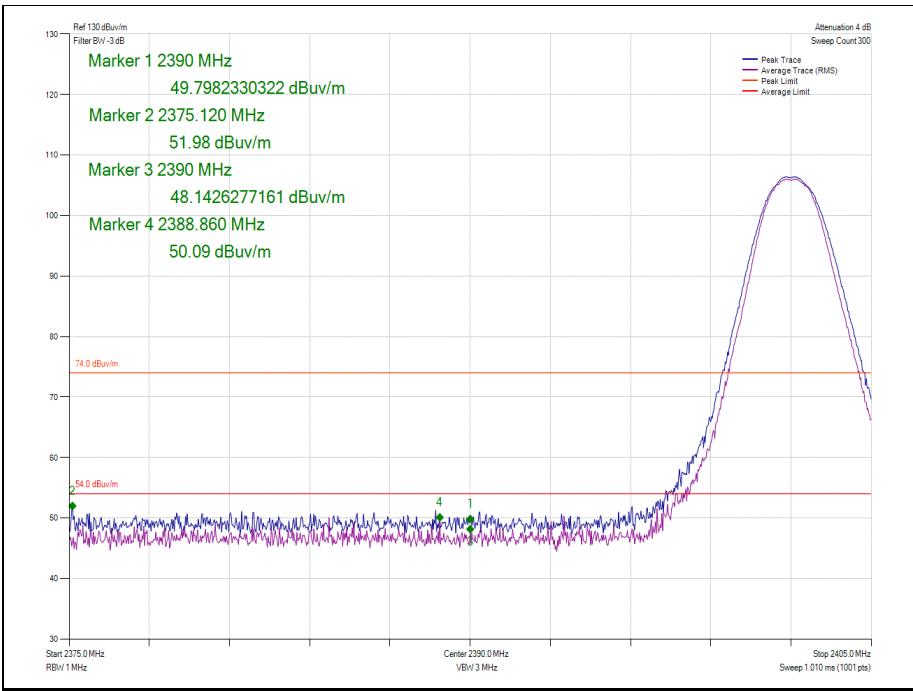


Figure 53- Static - $\pi/4$ DQPSK/2DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

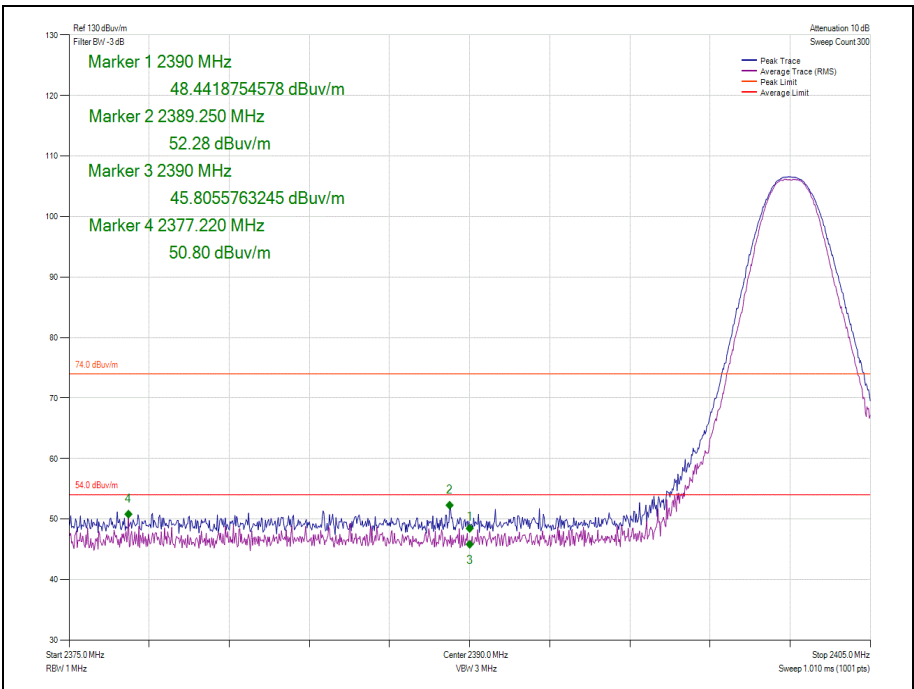


Figure 54- Static - 8-DPSK/3DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

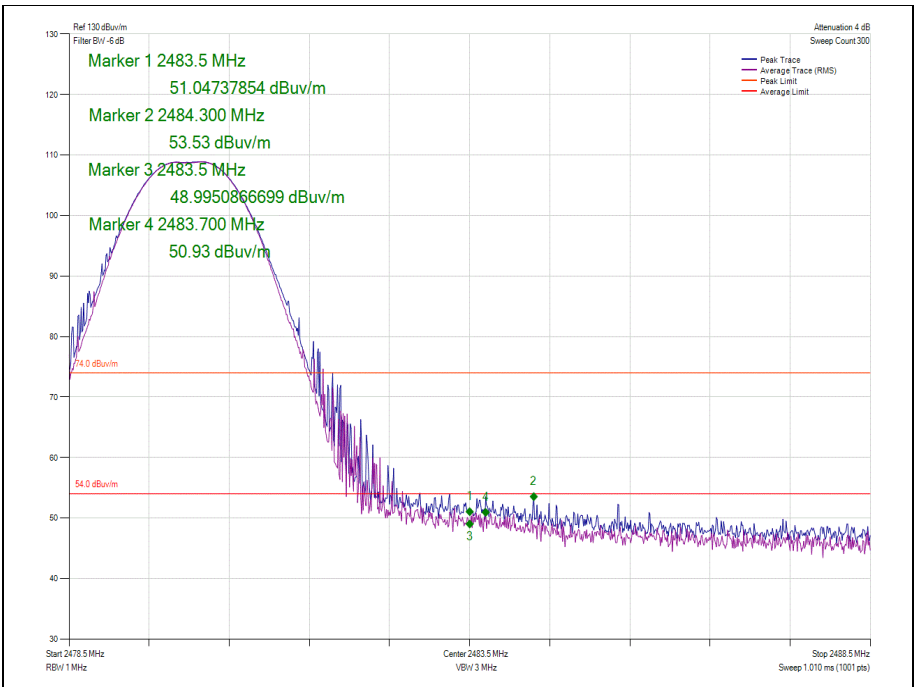


Figure 55 - Static - GFSK/DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

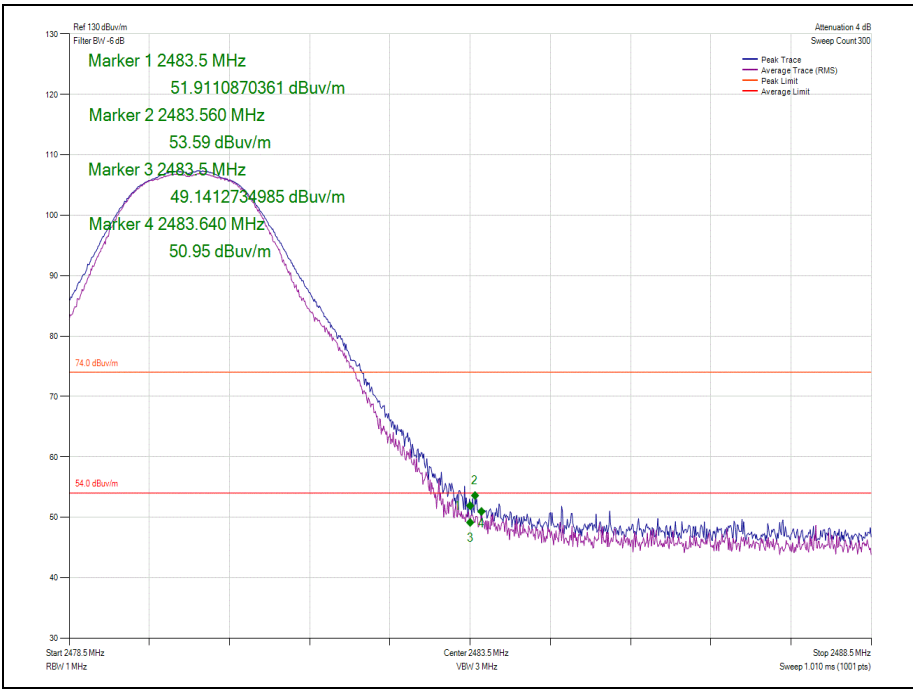


Figure 56- Static - $\pi/4$ DQPSK/2DH5 - 2480 MHz - Measured Frequency 2483.5 MHz

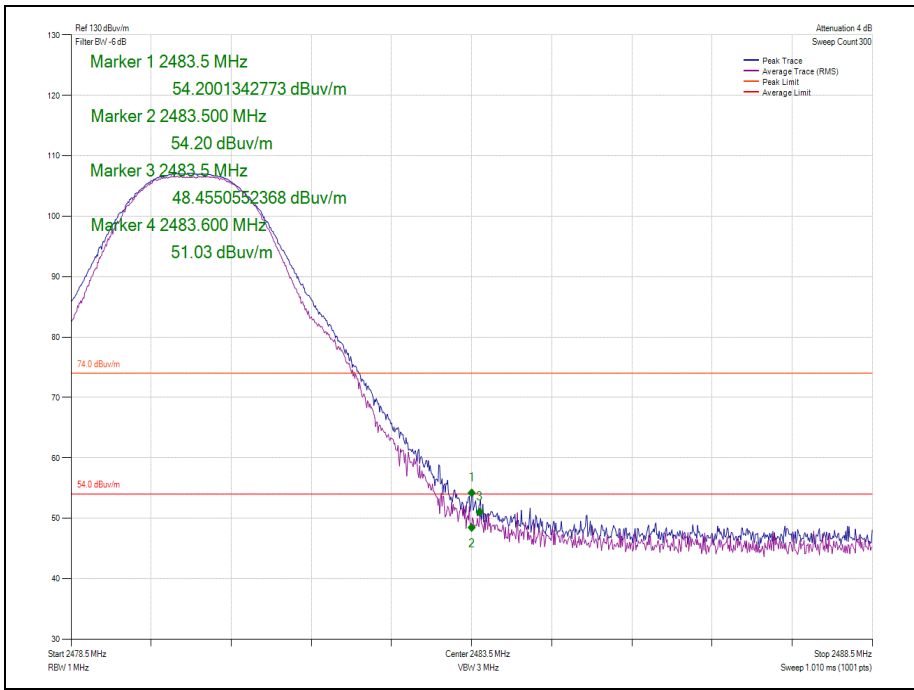


Figure 57- Static - 8-DPSK/3DH5 - 2480 MHz - Measured Frequency 2483.5 MHz



FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$ at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 20

Industry Canada RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$ at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

Table 21

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.



Bluetooth EDR - ePA

Mode	Modulation	Packet Type	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Hopping	$\pi/4$ DQPSK	2DH5	2402	2390.0	53.19	46.87
Hopping	8-DPSK	3DH5	2402	2390.0	53.43	47.30
Hopping	$\pi/4$ DQPSK	2DH5	2480	2483.5	53.67	49.40
Hopping	8-DPSK	3DH5	2480	2483.5	53.20	48.57
Static	$\pi/4$ DQPSK	2DH5	2402	2390.0	51.93	49.46
Static	8-DPSK	3DH5	2402	2390.0	51.20	49.63
Static	$\pi/4$ DQPSK	2DH5	2480	2483.5	53.96	51.04
Static	8-DPSK	3DH5	2480	2483.5	52.75	51.14

Table 22

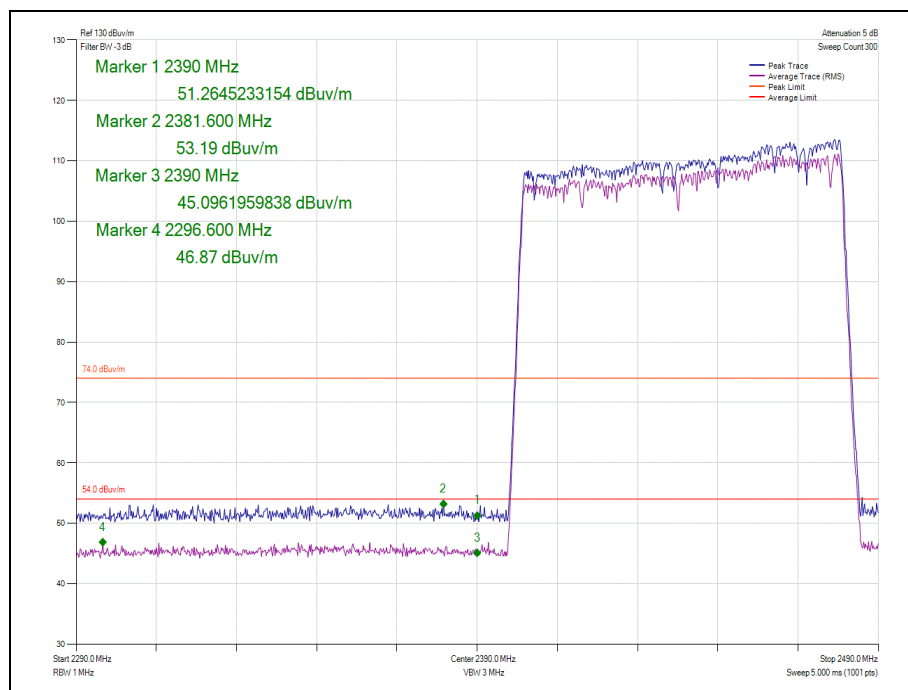


Figure 58- Hopping - $\pi/4$ DQPSK/2DH5 - Measured Frequency 2390.0 MHz

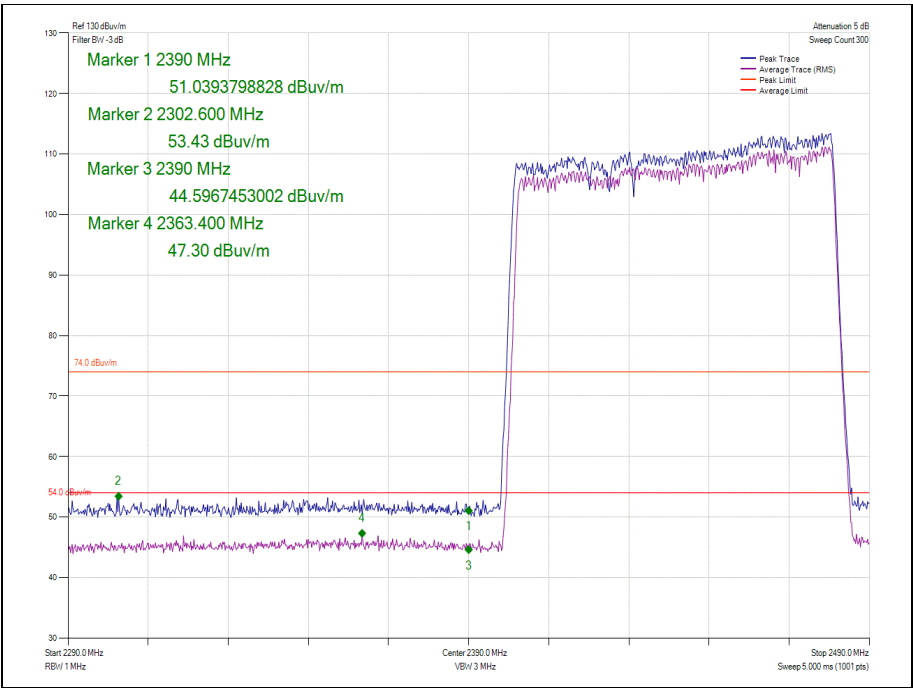


Figure 59- Hopping - 8-DPSK/3DH5 - Measured Frequency 2390.0 MHz

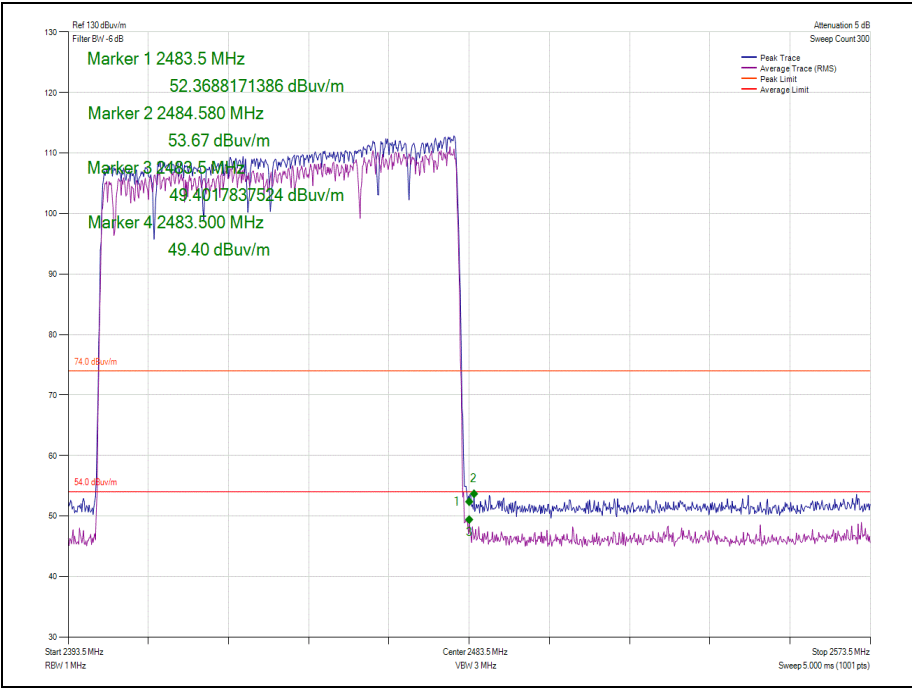


Figure 60- Hopping - $\pi/4$ DQPSK/2DH5 - Measured Frequency 2483.5 MHz



Figure 61- Hopping - 8-DPSK/3DH5 - Measured Frequency 2483.5 MHz

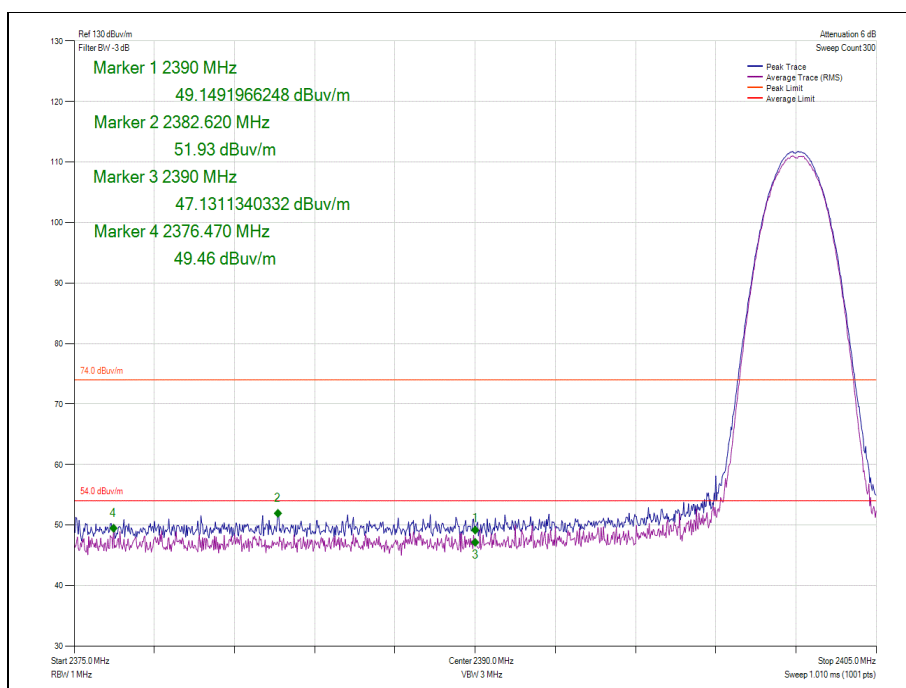


Figure 62- Static - $\pi/4$ DQPSK/2DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

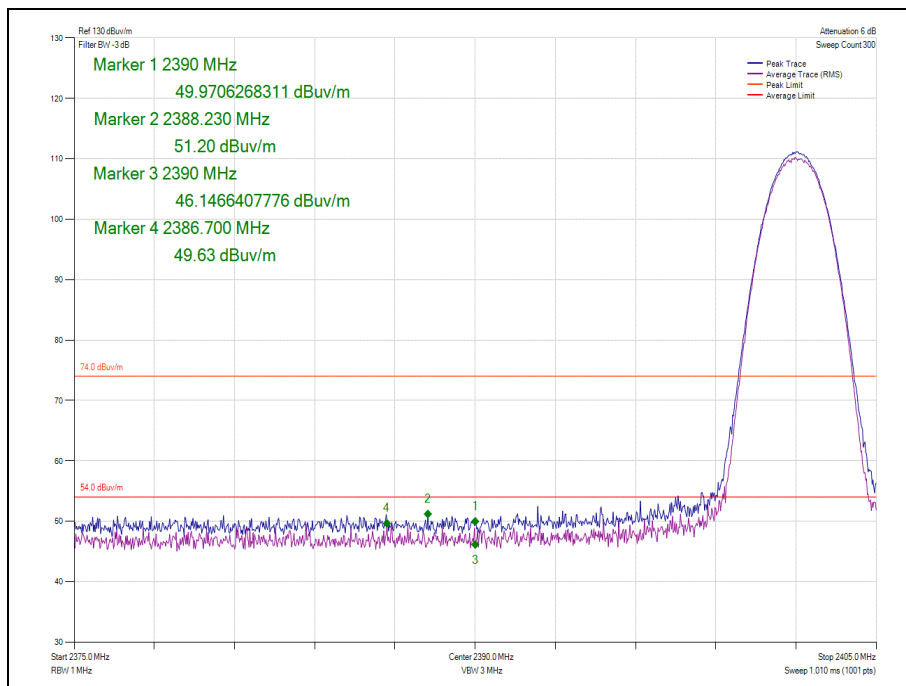


Figure 63- Static - 8-DPSK/3DH5 - 2402 MHz - Measured Frequency 2390.0 MHz

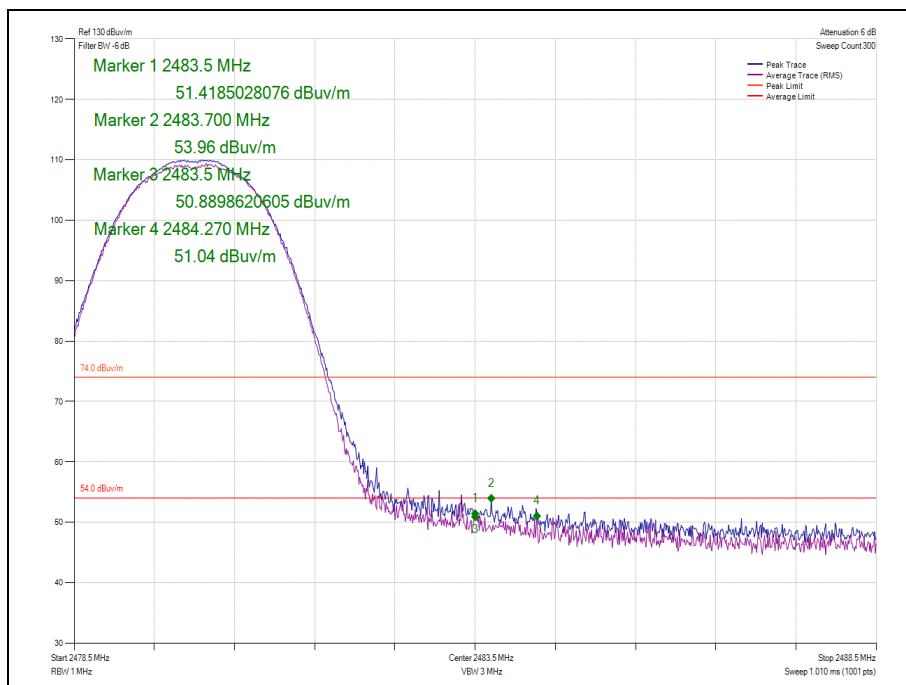


Figure 64- Static - $\pi/4$ DQPSK/2DH5 - 2480 MHz - Measured Frequency 2483.5 MHz



Product Service

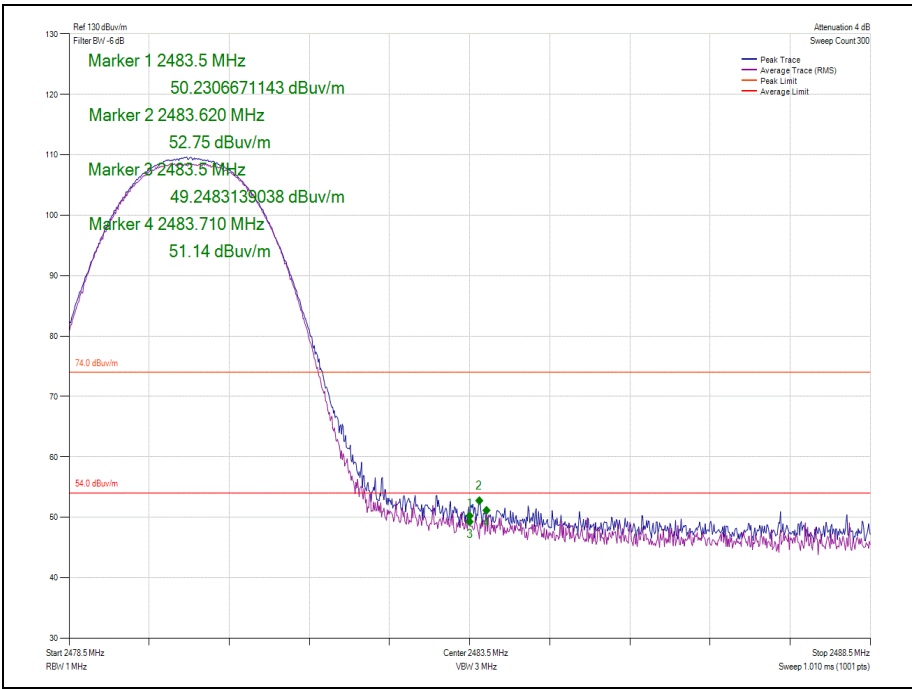


Figure 65- Static - 8-DPSK/3DH5 - 2480 MHz - Measured Frequency 2483.5 MHz



FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$ at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 23

Industry Canada RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$ at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

Table 24

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.



2.6.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Hygrometer	Rotronic	HP21	4989	12	26-April-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	9-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Cable	Rosenberger	LU7-071-1000	5104	6	05-Oct-2019
Cable	Rosenberger	LU7-071-2000	4528	-	O/P Mon
Cable	Rosenberger	2303-0 9.0m PNm PNm	4827	12	04-Jan-2019
EMI Receiver	Keysight Technologies	N9038A MXE	4628	12	04-July-2019

Table 25

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.7 Spurious Radiated Emissions

2.7.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205
Industry Canada RSS-247, Clause 5.5
Industry Canada RSS-GEN, Clause 6.13

2.7.2 Equipment Under Test and Modification State

A1932, S/N: C02WG001JV8M - Modification State 0

2.7.3 Date of Test

26-September-2018 to 28-September-2018

2.7.4 Test Method

Testing was performed in accordance with ANSI C63.10 clause 6.3, 6.5 and 6.6.

In the 30MHz to 1GHz range pre scans were only performed on mid channel (2441 MHz) and any emissions identified then measured on bottom (2402 MHz) and top (2480 MHz).

Plots for average measurements were taken in accordance with ANSI C63.10-2013 using an average detector and max hold trace to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10-2013 clause 4.1.4.2.2.

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (54/74 dBuV/m @ 3m and 64/84 dBuV/m @ 1m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dBuV/m to $\mu\text{V/m}$:
 $10^{(\text{Field Strength in dBuV/m}/20)}$.

2.7.5 Environmental Conditions

Ambient Temperature	22.8 °C
Relative Humidity	41.1 %



2.7.6 Test Results

Bluetooth BDR/EDR - iPA

Testing was performed with the device operating at maximum power, using the Modulation/Packet type DH5.

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 26 - 2441 MHz - 30 MHz to 1 GHz Emissions Results

*No emissions were detected within 10 dB of the limit.

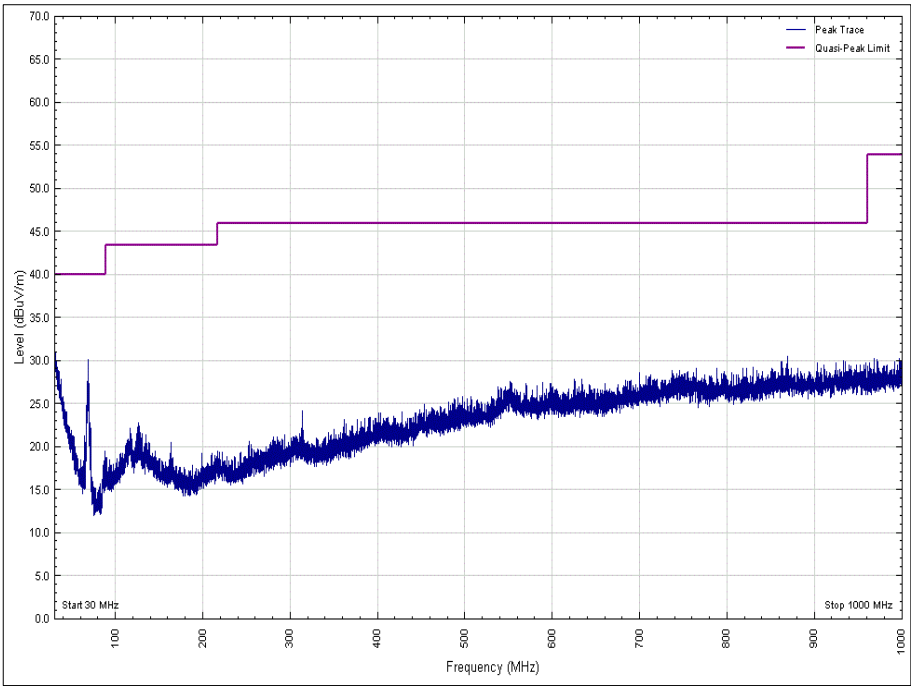


Figure 66 - 2441 MHz - 30 MHz to 1 GHz Horizontal

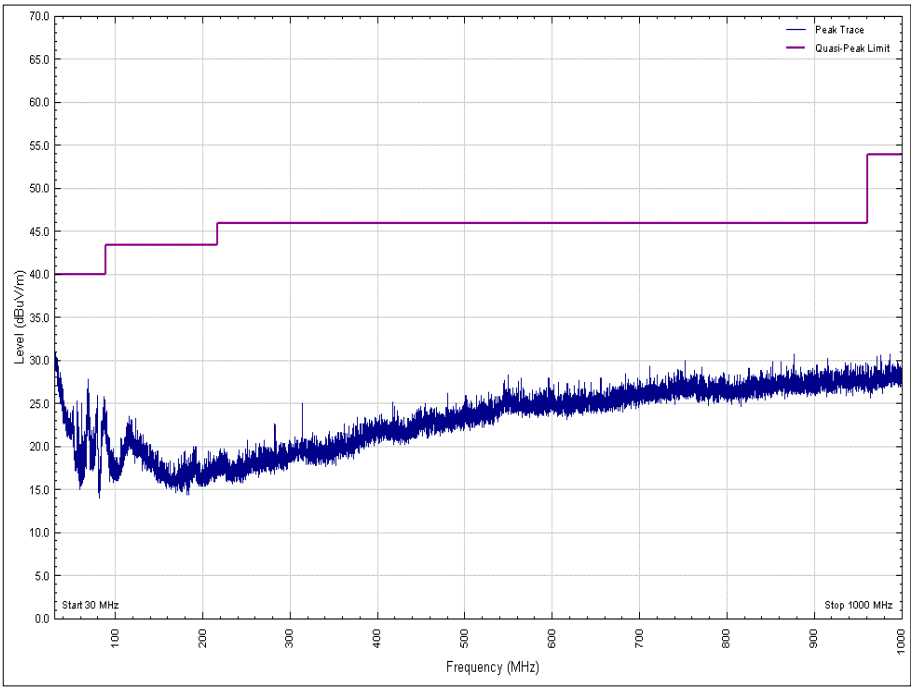


Figure 67 - 2441 MHz - 30 MHz to 1 GHz Vertical

2402 MHz

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
4.803	50.57	47.36	74.0	54.0	23.43	6.64

Table 27 - 1 GHz to 26 GHz - Radiated

No other emissions were detected within 10 dB of the limit.

Note - The emissions seen at 2402 MHz is the EUT’s intentional transmitter frequency and is therefore not subject to this test.

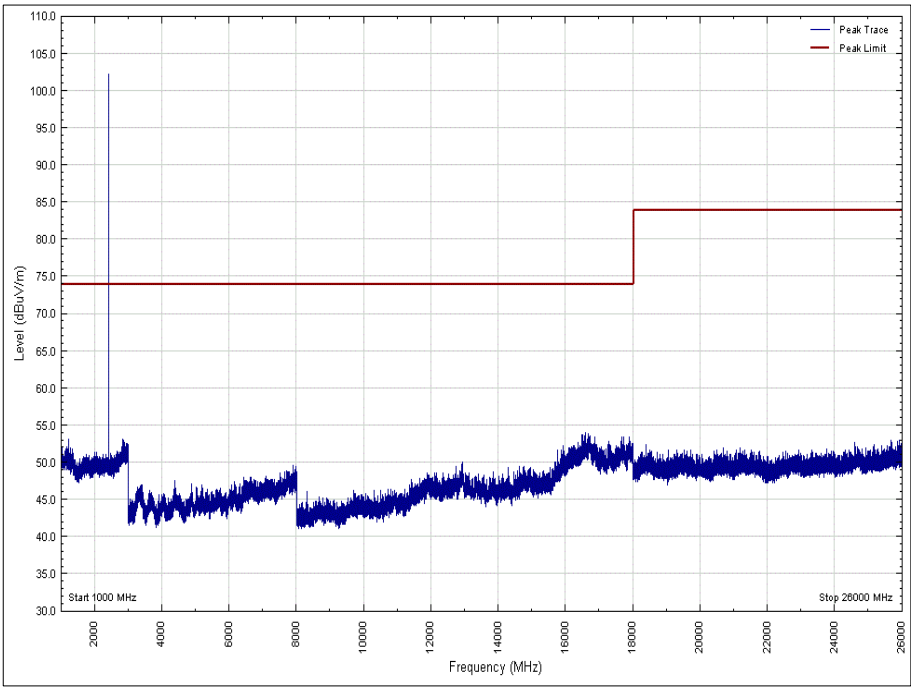


Figure 68 - 2402 MHz - 1 GHz to 26 GHz – Horizontal (Peak)

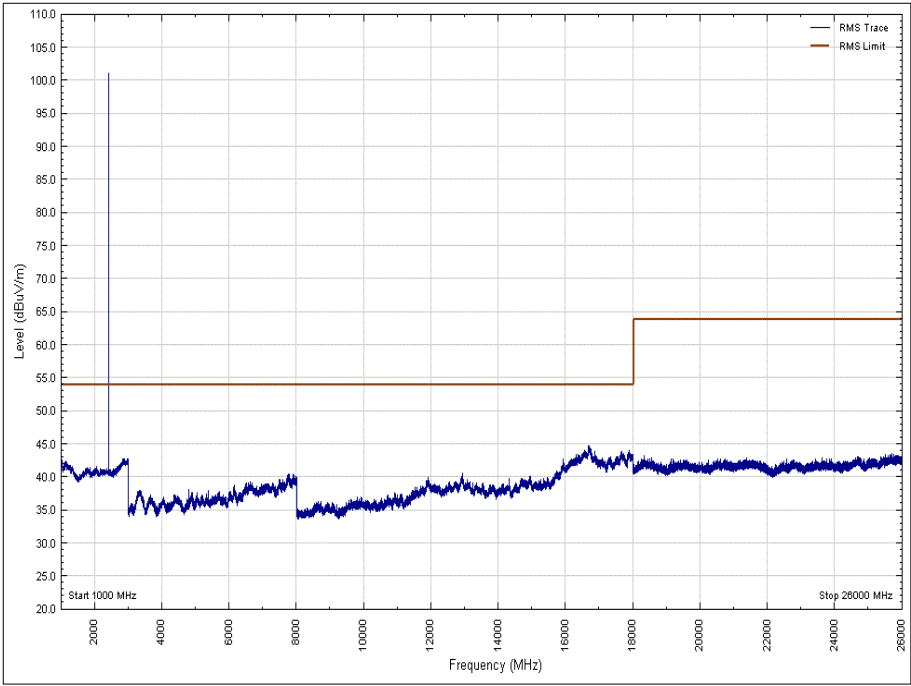


Figure 69 - 2402 MHz - 1 GHz to 26 GHz – Horizontal (Average)

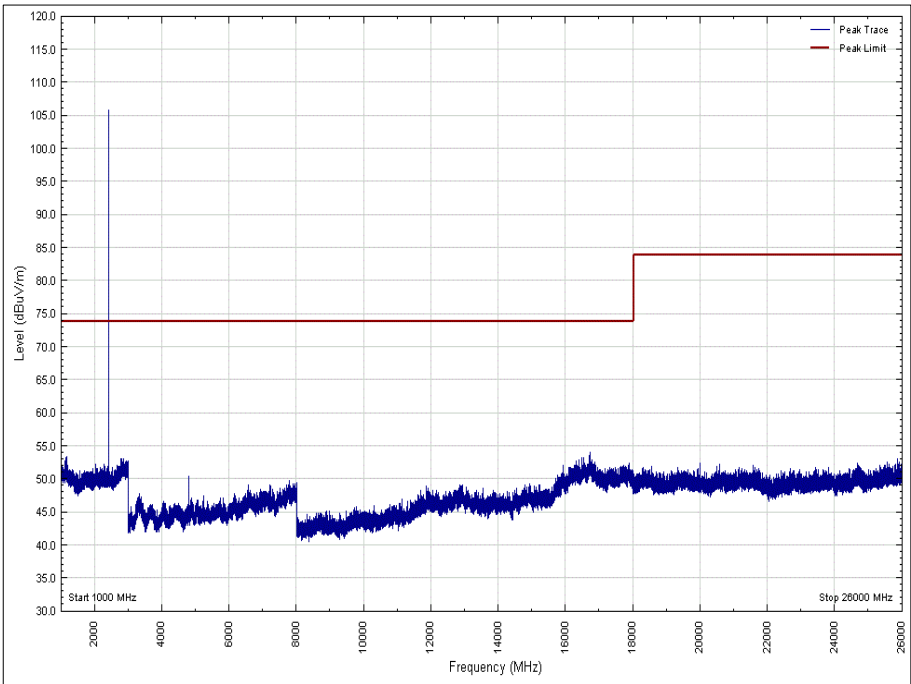


Figure 70 - 2402 MHz - 1 GHz to 26 GHz - Vertical (Peak)

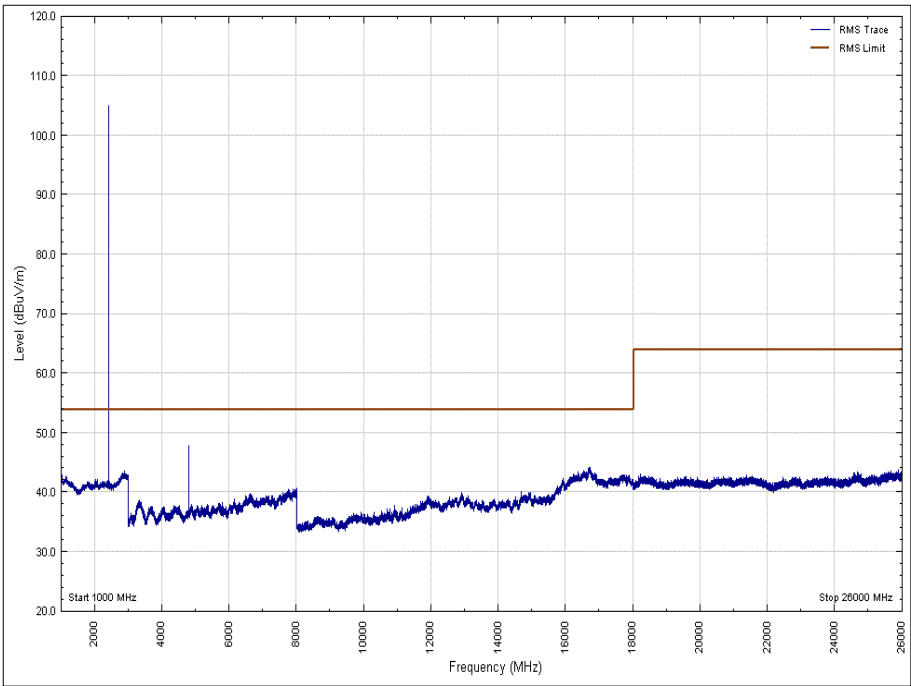


Figure 71 - 2402 MHz - 1 GHz to 26 GHz – Vertical (Average)



2441 MHz

Frequency (GHz)	Result (dBμV/m)		Limit (dBμV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
4.882	51.76	47.46	74.0	54.0	22.24	6.54

Table 28 - 1 GHz to 26 GHz - Radiated

No other emissions were detected within 10 dB of the limit.

Note - The emissions seen at 2441 MHz is the EUT’s intentional transmitter frequency and is therefore not subject to this test.

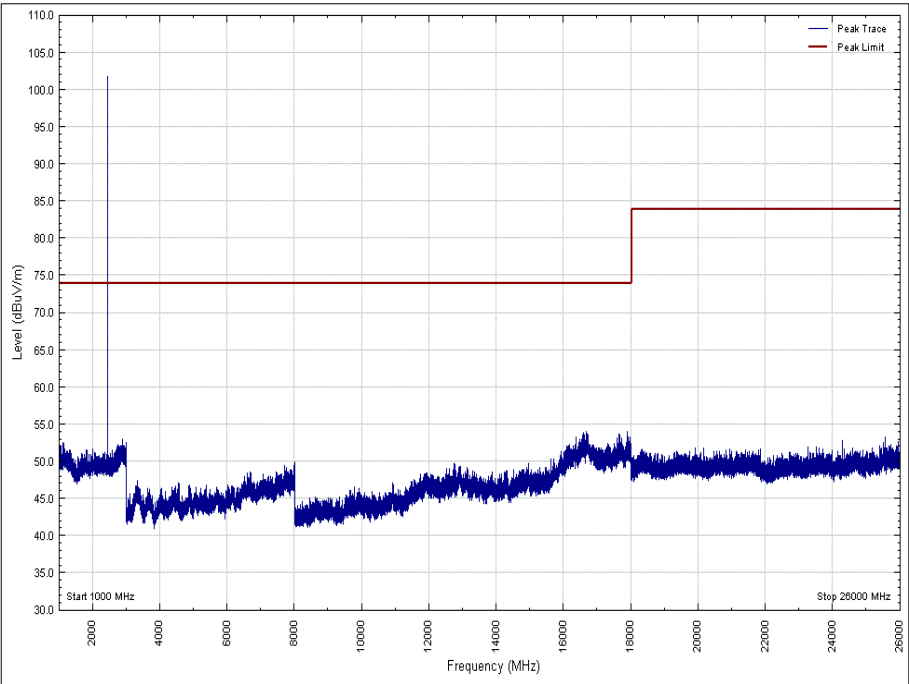


Figure 72 - 2441 MHz - 1 GHz to 26 GHz Horizontal (Peak)

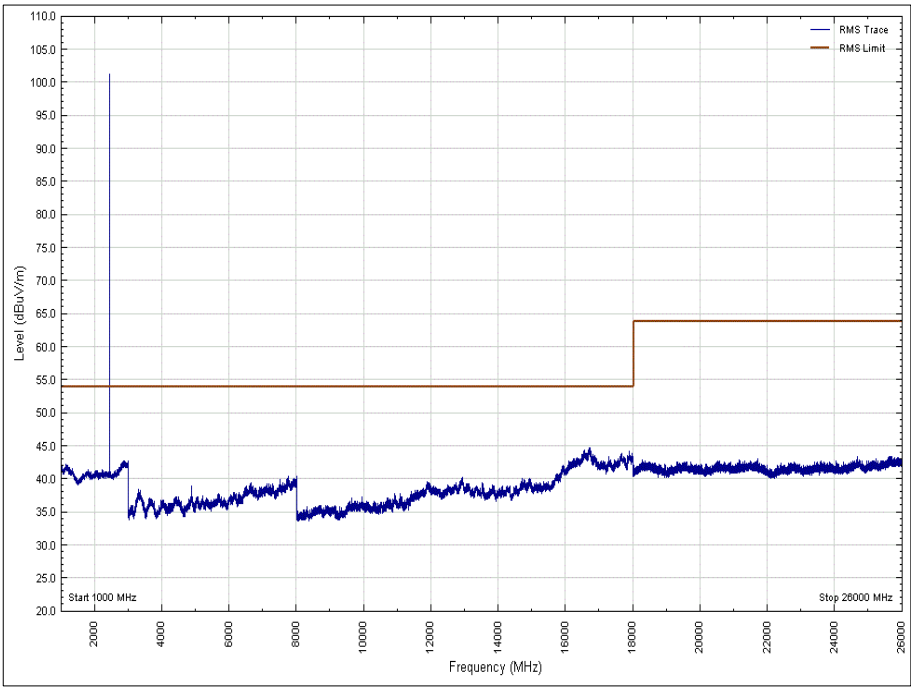


Figure 73 - 2441 MHz - 1 GHz to 26 GHz Horizontal (Average)

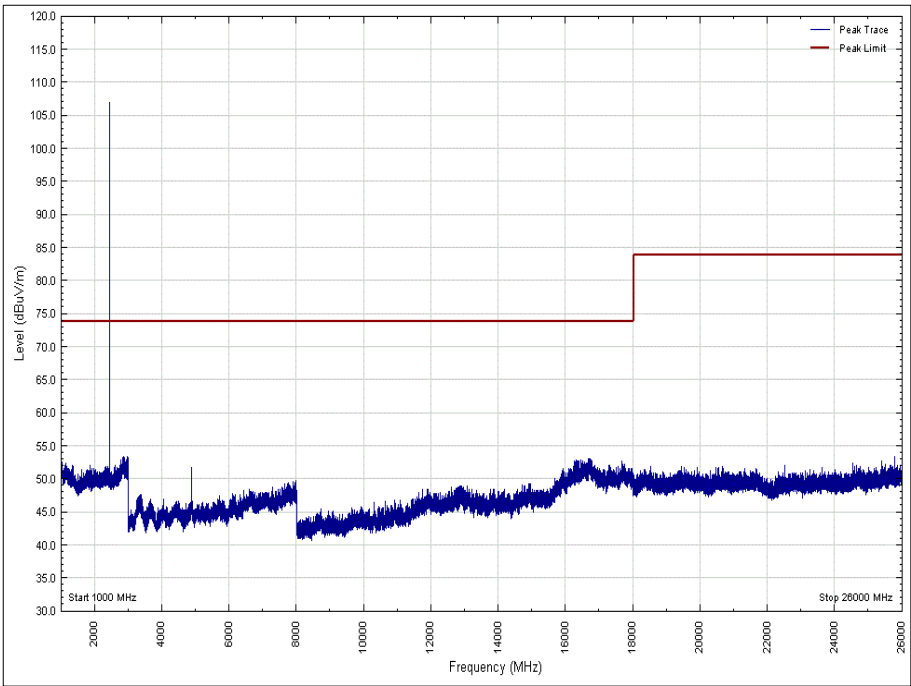


Figure 74 - 2441 MHz - 1 GHz to 26 GHz Vertical (Peak)

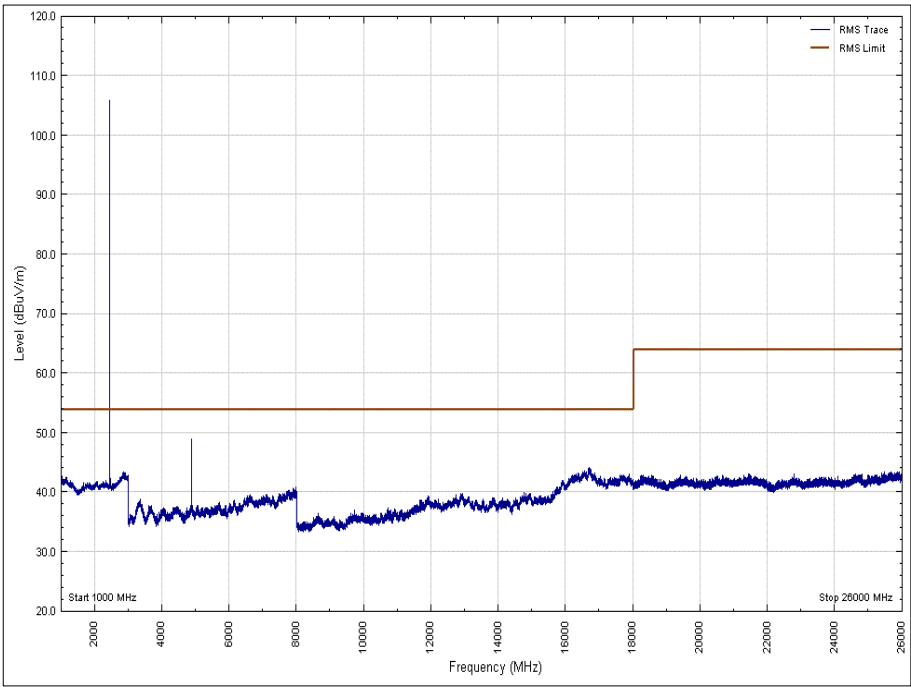


Figure 75 - 2441 MHz - 1 GHz to 26 GHz Vertical (Average)

2480 MHz

Frequency (GHz)	Result (dBμV/m)		Limit (dBμV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
4.960	49.74	47.55	74.0	54.0	24.26	6.45

Table 29 - 1 GHz to 26 GHz - Radiated

No emissions other emissions were detected within 10 dB of the limit.

Note - The emissions seen at 2480 MHz is the EUT’s intentional transmitter frequency and is therefore not subject to this test.

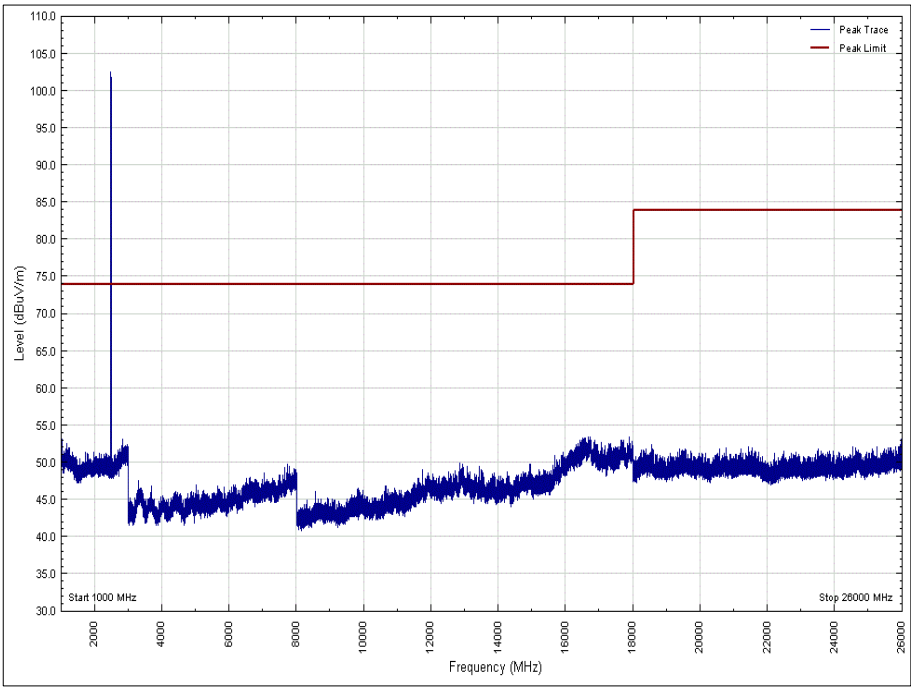


Figure 76 - 2480 MHz - 1 GHz to 26 GHz Horizontal (Peak)

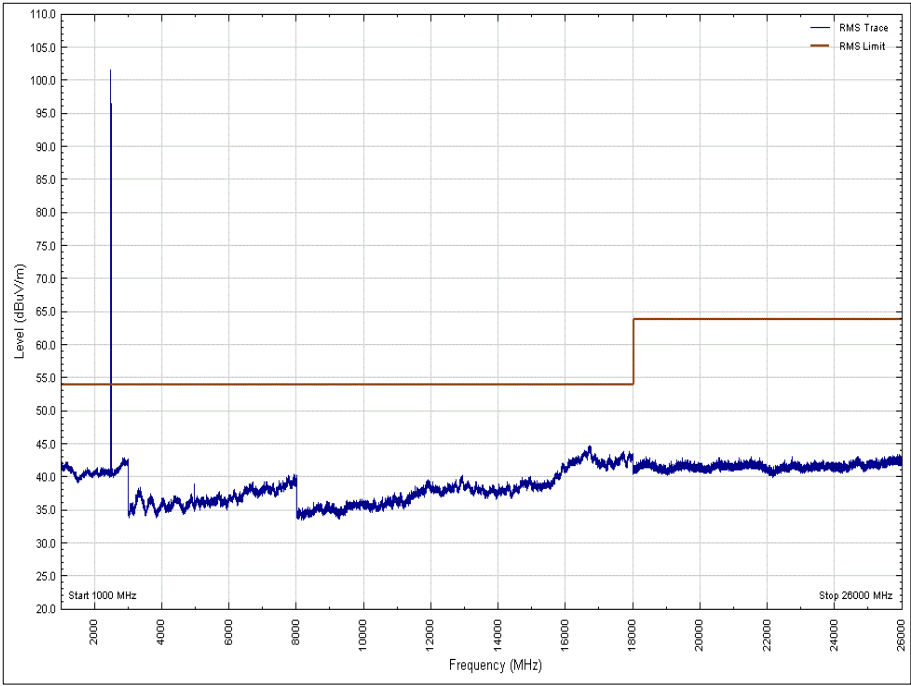


Figure 77 - 2480 MHz - 1 GHz to 26 GHz Horizontal (Average)

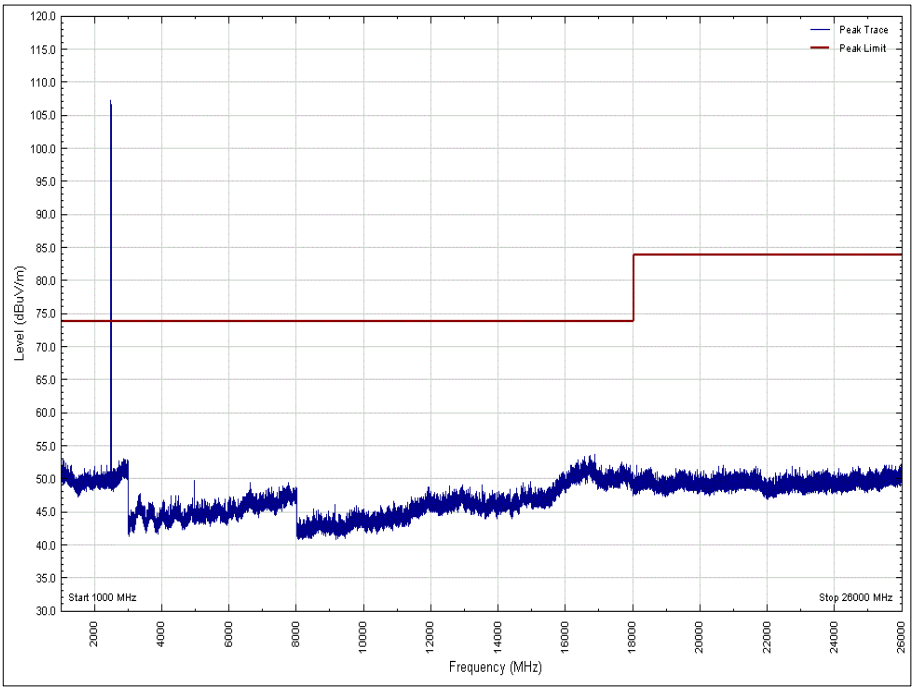


Figure 78 - 2480 MHz - 1 GHz to 26 GHz Vertical (Peak)

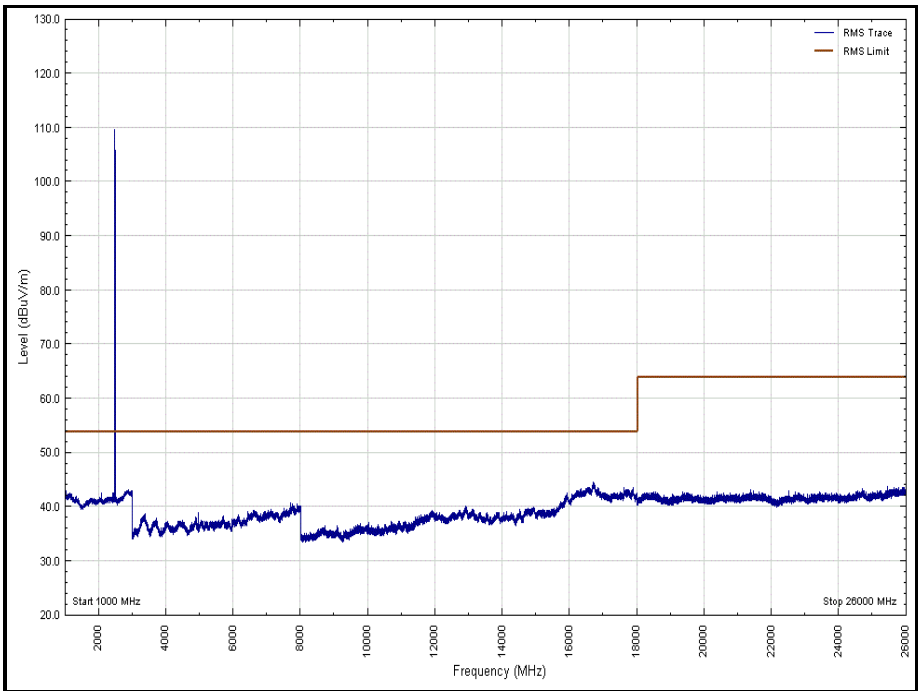


Figure 79 - 2480 MHz - 1 GHz to 26 GHz Vertical (Average)



FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.



Bluetooth EDR - ePA

Testing was performed with the device operating at maximum power, using the Modulation/Packet type 3DH5.

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 30 - 2441 MHz - 30 MHz to 1 GHz Emissions Results

*No emissions were detected within 10 dB of the limit.

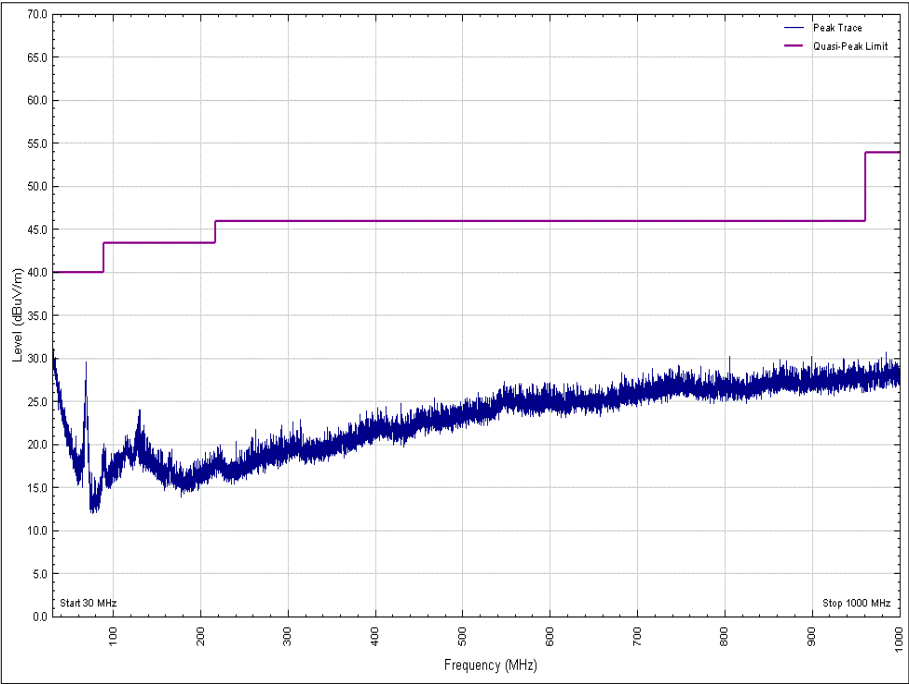


Figure 80 - 2441 MHz - 30 MHz to 1 GHz Horizontal

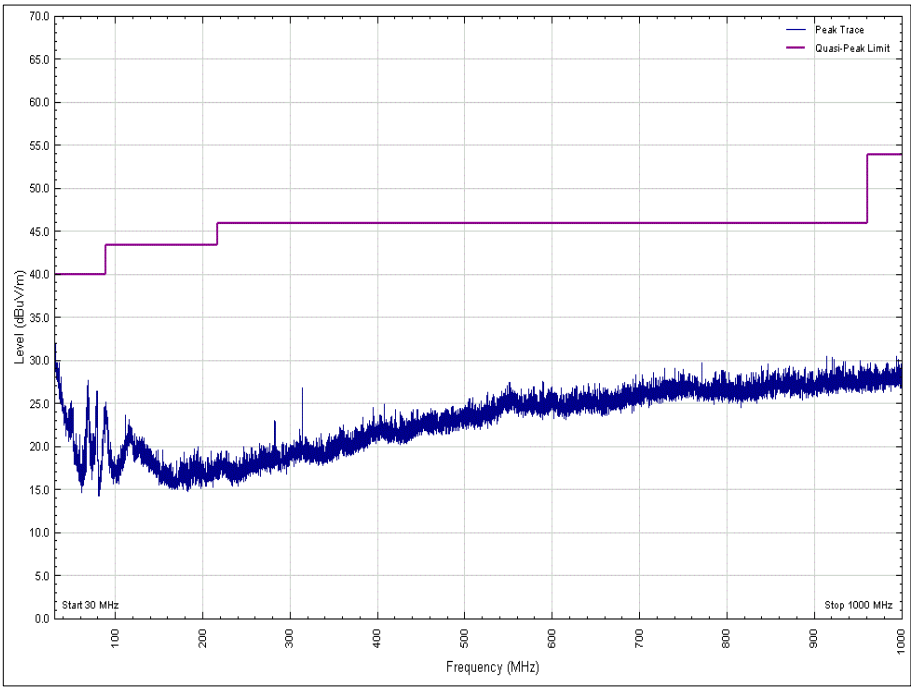


Figure 81 - 2441 MHz - 30 MHz to 1 GHz Vertical

2402 MHz

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 31 - 1 GHz to 26 GHz - Radiated

*No emissions were detected within 10 dB of the limit.

Note - The emissions seen at 2402 MHz is the EUT’s intentional transmitter frequency and is therefore not subject to this test.

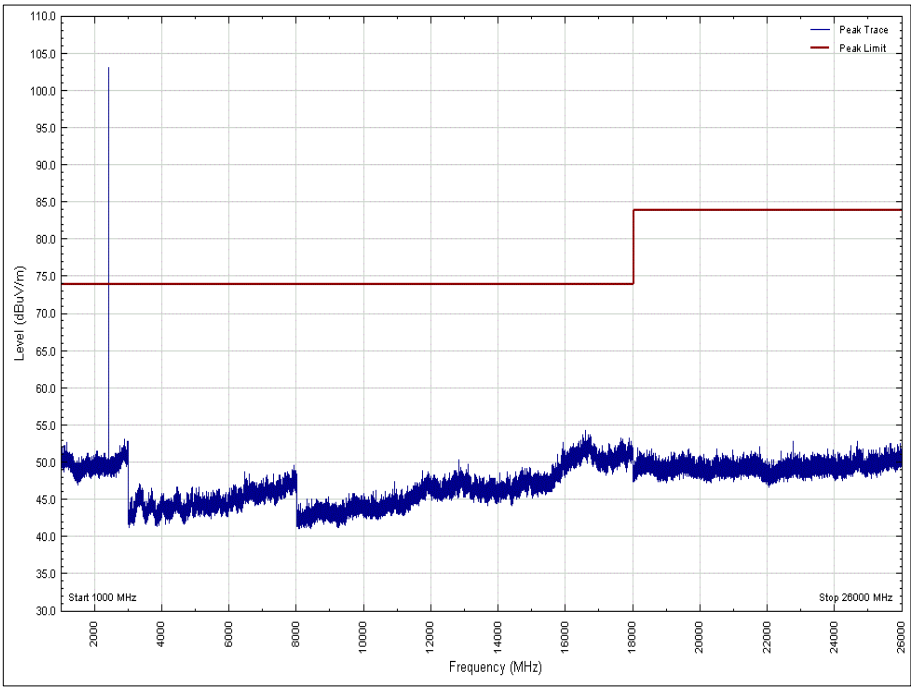


Figure 82 - 2402 MHz - 1 GHz to 26 GHz – Horizontal (Peak)

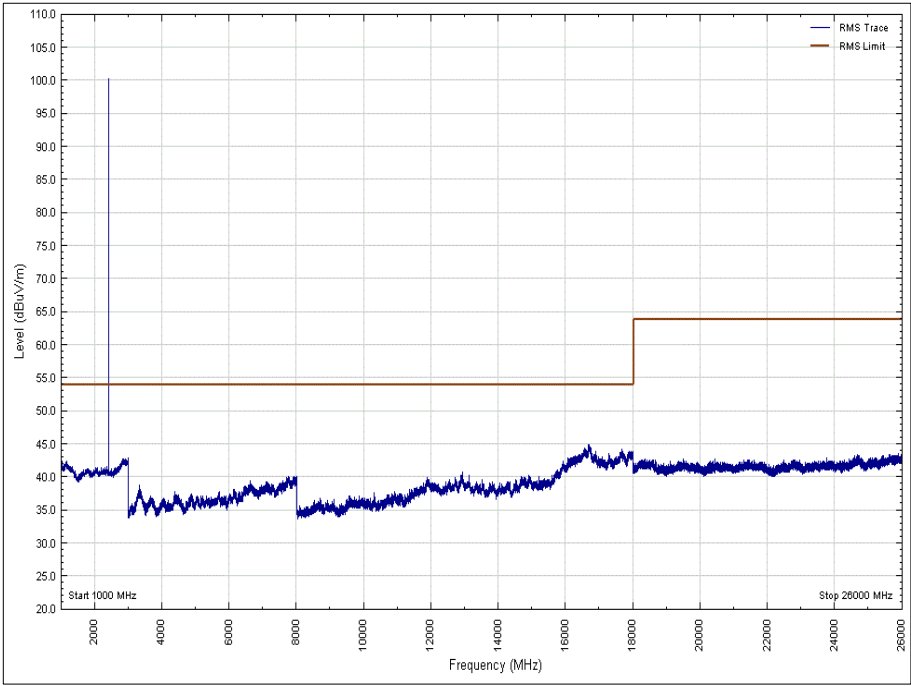


Figure 83 - 2402 MHz - 1 GHz to 26 GHz – Horizontal (Average)

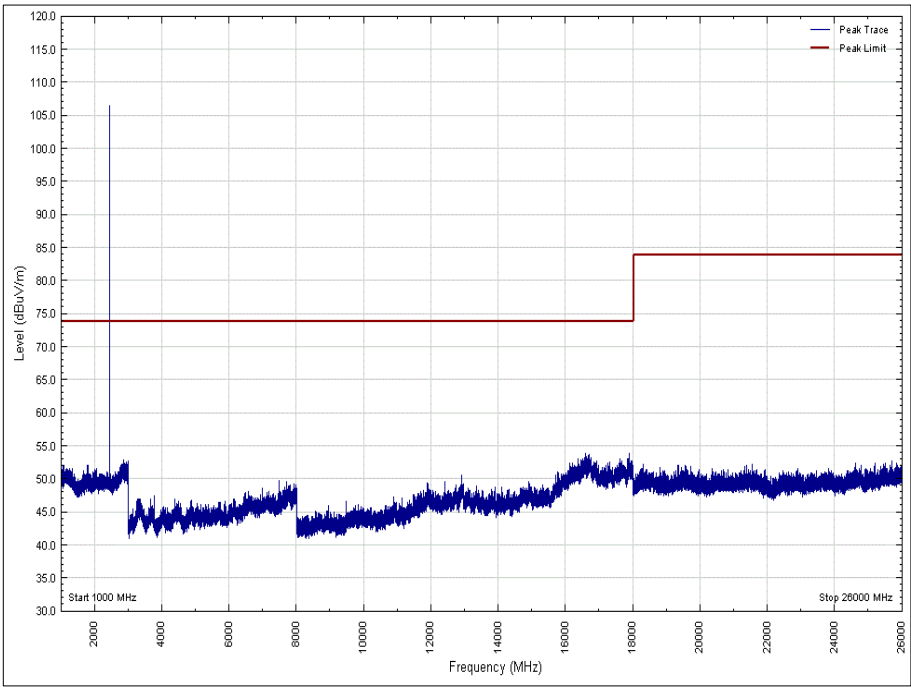


Figure 84 - 2402 MHz - 1 GHz to 26 GHz - Vertical (Peak)

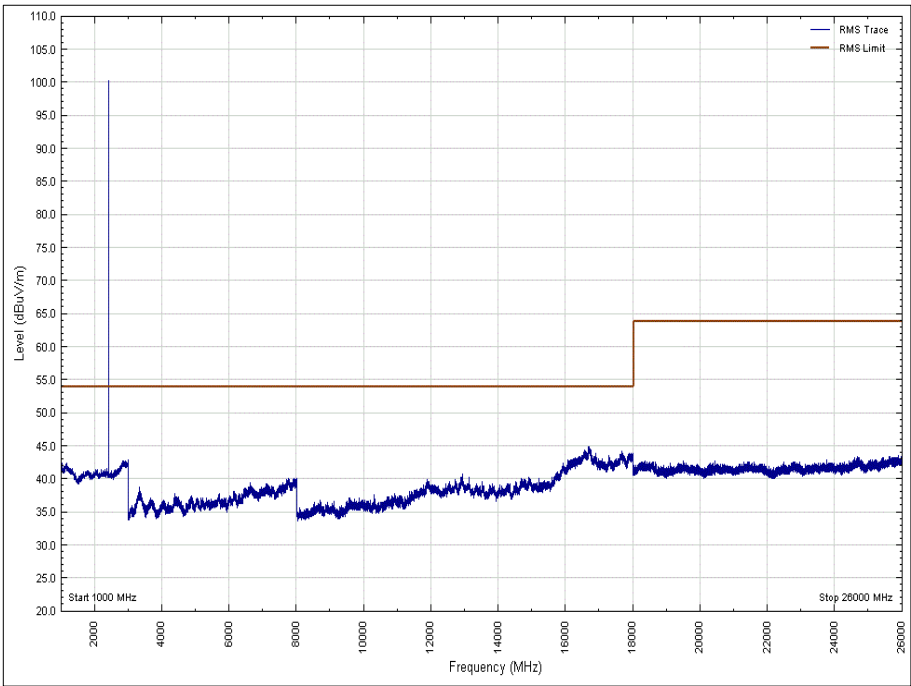


Figure 85 - 2402 MHz - 1 GHz to 26 GHz – Vertical (Average)



2441 MHz

Frequency (GHz)	Result (dBμV/m)		Limit (dBμV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 32 - 1 GHz to 26 GHz - Radiated

*No emissions were detected within 10 dB of the limit.

Note - The emissions seen at 2441 MHz is the EUT’s intentional transmitter frequency and is therefore not subject to this test.

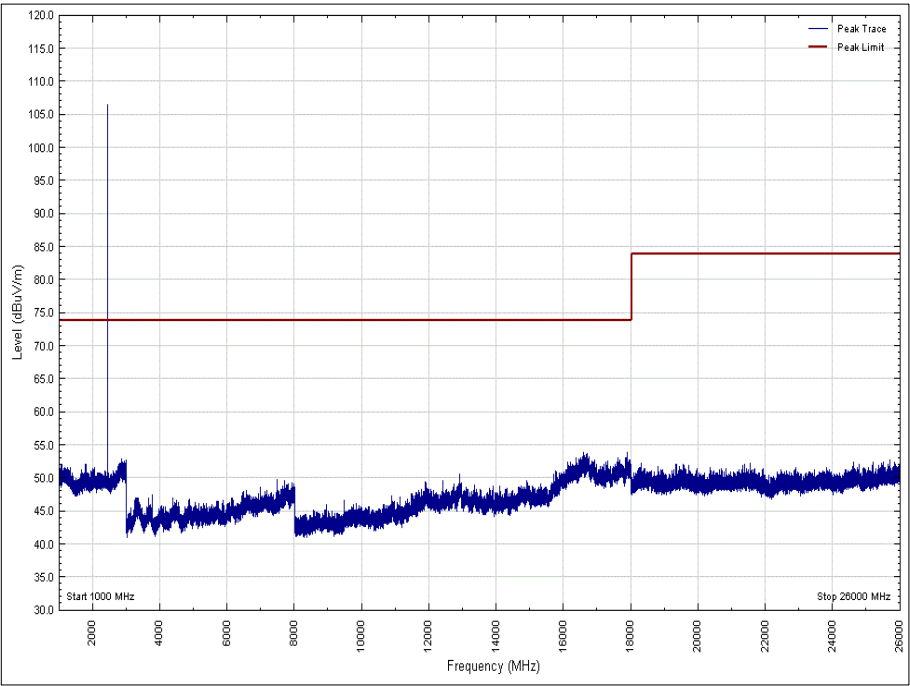


Figure 86 - 2441 MHz - 1 GHz to 26 GHz Horizontal (Peak)

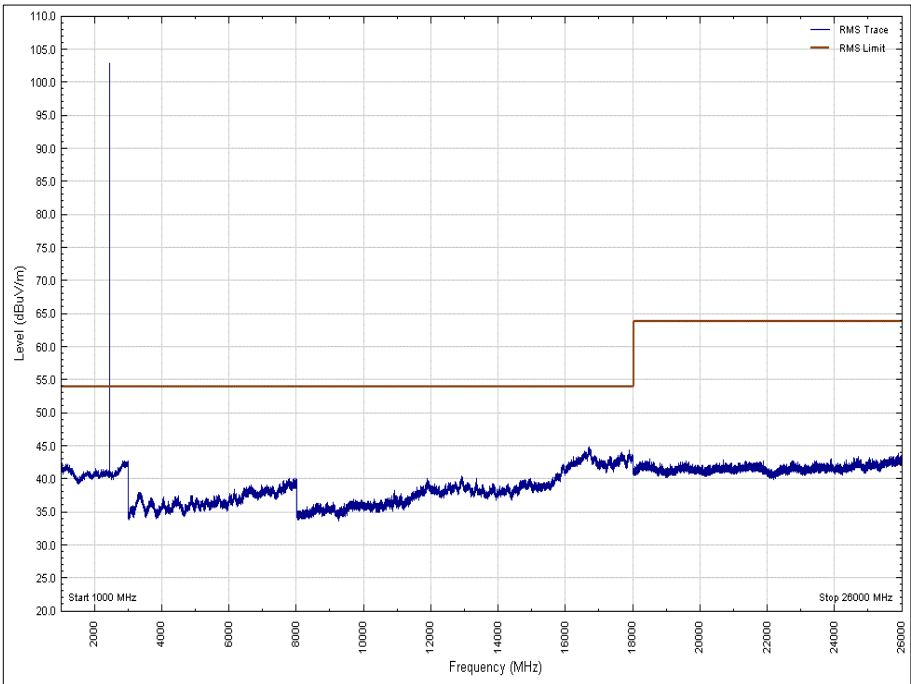


Figure 87 - 2441 MHz - 1 GHz to 26 GHz Horizontal (Average)

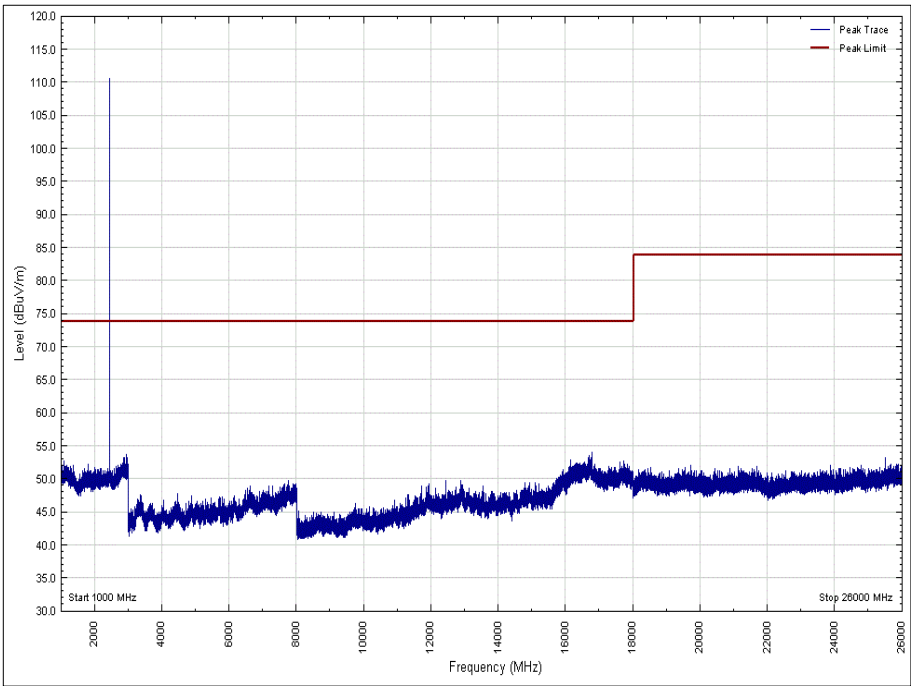


Figure 88 - 2441 MHz - 1 GHz to 26 GHz Vertical (Peak)

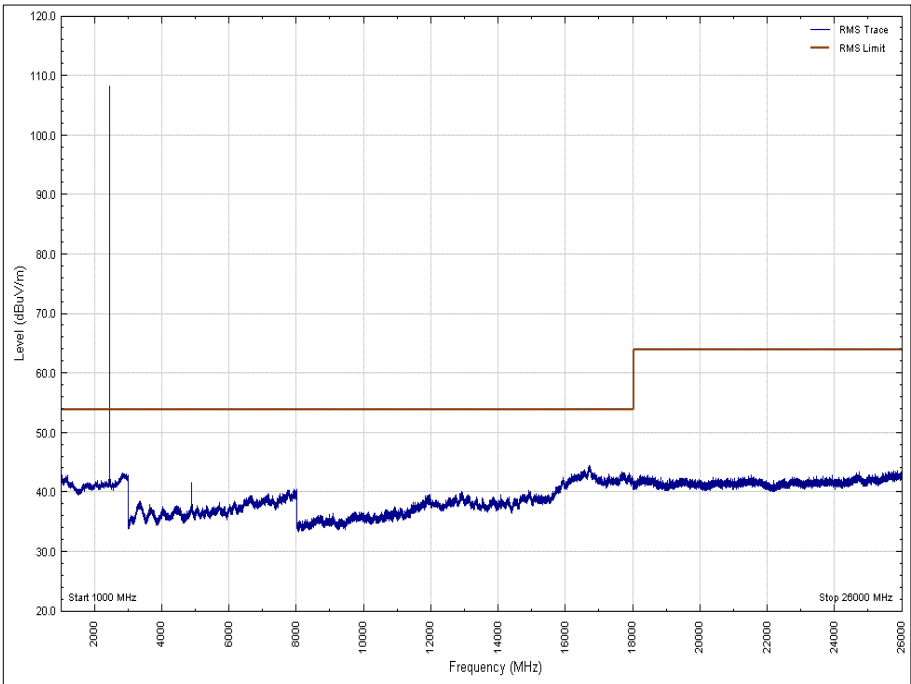


Figure 89 - 2441 MHz - 1 GHz to 26 GHz Vertical (Average)



2480 MHz

Frequency (GHz)	Result (dBμV/m)		Limit (dBμV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 33 - 1 GHz to 26 GHz - Radiated

*No emissions were detected within 10 dB of the limit.

Note - The emissions seen at 2480 MHz is the EUT’s intentional transmitter frequency and is therefore not subject to this test.

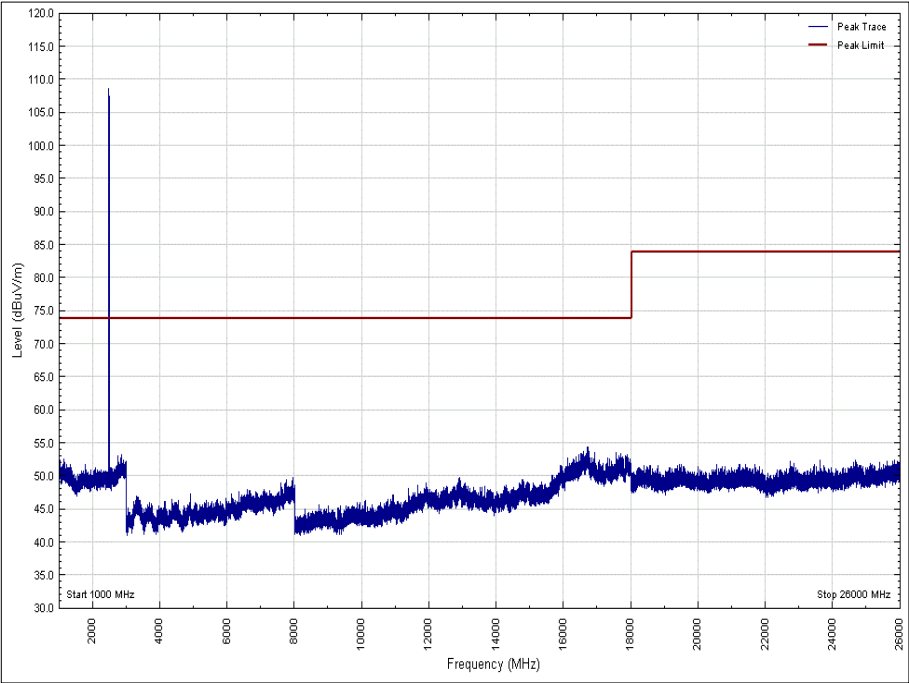


Figure 90 - 2480 MHz - 1 GHz to 26 GHz Horizontal (Peak)

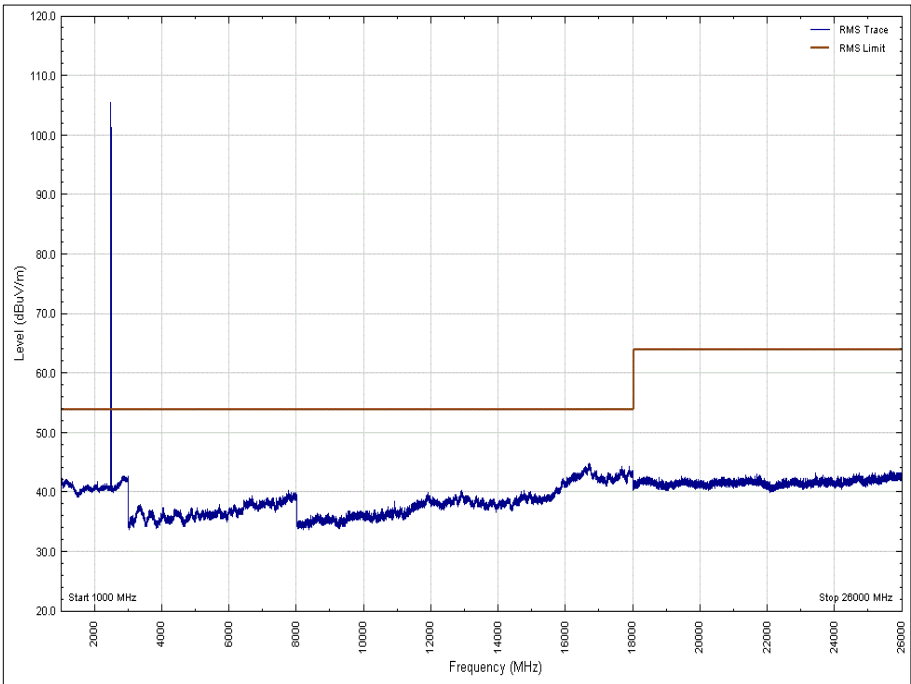


Figure 91 - 2480 MHz - 1 GHz to 26 GHz Horizontal (Average)

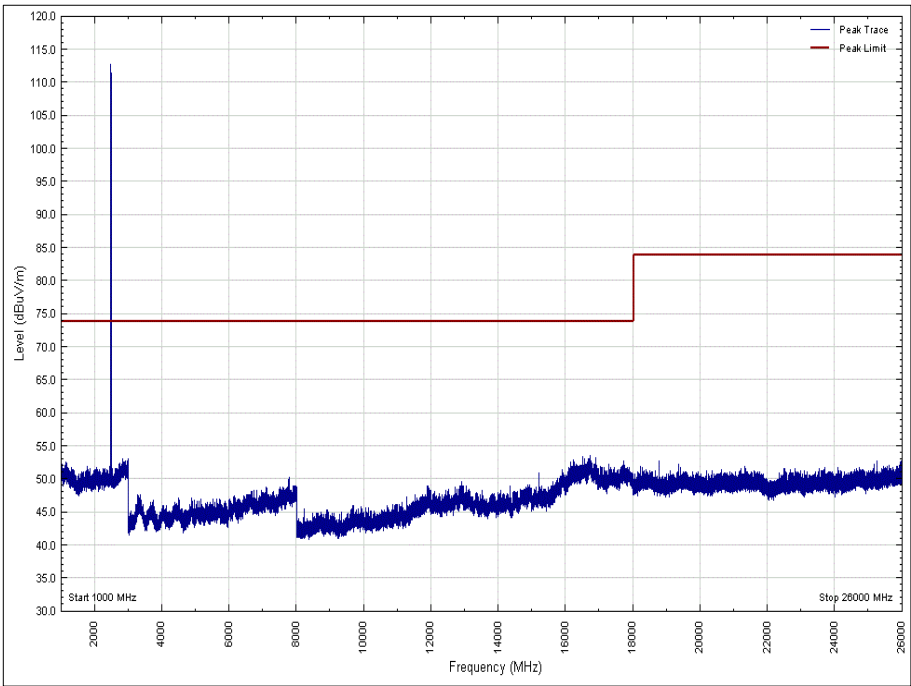


Figure 92 - 2480 MHz - 1 GHz to 26 GHz Vertical (Peak)

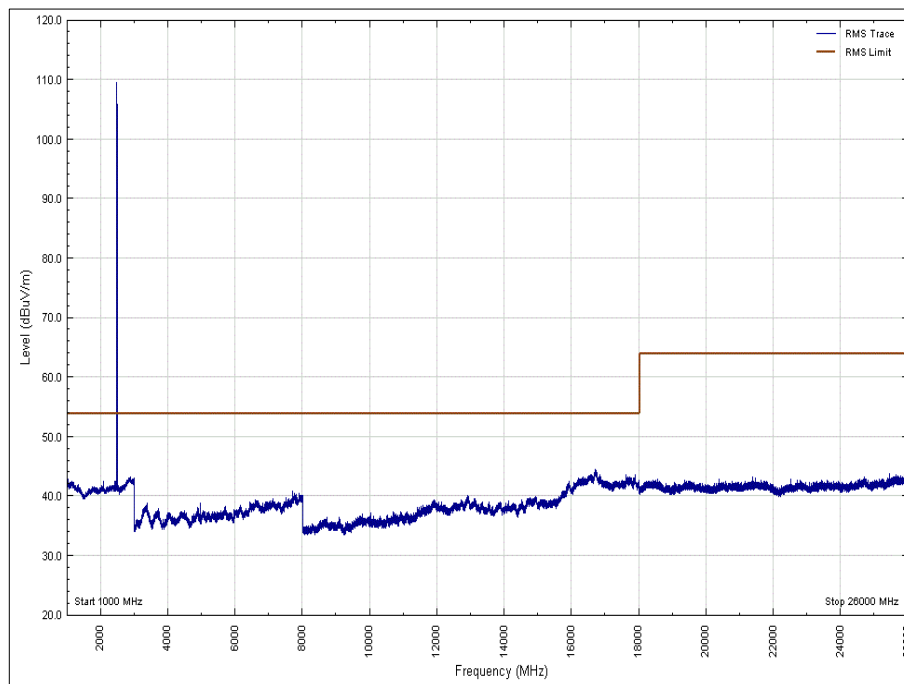


Figure 93 - 2480 MHz - 1 GHz to 26 GHz Vertical (Average)

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.



2.7.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	24-Nov-2018
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	02-May-2020
Antenna (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
Dual Power Supply Unit	Thurlby	PL320	288	-	TU
Filter (High Pass)	Lorch	SHP7-7000-SR	566	12	10-May-2019
Pre-Amplifier	Phase One	PS04-0086	1533	12	12-Jan-2019
18GHz - 40GHz Pre-Amplifier	Phase One	PS04-0087	1534	12	02-Feb-2019
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna (Bilog)	Chase	CBL6143	2904	24	08-Aug-2019
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	-	O/P Mon
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
1501A 4.0M Km Km Cable	Rhophase	KPS-1501A-4000-KPS	4301	12	19-Feb-2019
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	18-Oct-2018
Cable (Rx, Nm-Nm, 7m)	Scott Cables	SLU18-NMNM-07.00M	4498	-	O/P Mon
EMI Receiver	Keysight Technologies	N9038A MXE	4628	12	04-July-2019
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	01-Mar-2019
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
9m N type RF cable	Rosenberger	2303-0 9.0m PNm PNm	4827	6	04-Jan-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019
4dB Attenuator	Pasternack	PE7047-4	4935	12	28-Nov-2018
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
Cable (26.5GHz)	Rosenberger	LU7-133-5000	5019	-	O/P Mon
Cable (40GHz)	Rosenberger	LU1-001-2000	5020	-	O/P Mon



Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
9m N type RF cable	Rosenberger	2303-0 9.0m PNm PNm	4827	6	04-Jan-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019
4dB Attenuator	Pasternack	PE7047-4	4935	12	28-Nov-2018
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
Cable (26.5GHz	Rosenberger	LU7-133-5000	5019	-	O/P Mon
Cable (40GHz	Rosenberger	LU1-001-2000	5020	-	O/P Mon

Table 34

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.8 Maximum Conducted Output Power

2.8.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)(1)
Industry Canada RSS-247, Clause 5.4
Industry Canada RSS-GEN, Clause 6.12

2.8.2 Equipment Under Test and Modification State

A1932, S/N: C02X5004JL9H - Modification State 0

2.8.3 Date of Test

26-September-2018 to 27-September-2018

2.8.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.5.

2.8.5 Environmental Conditions

Ambient Temperature 26.7 - 26.9 °C
Relative Humidity 44.3 - 44.7 %

2.8.6 Test Results

Bluetooth BDR/EDR - iPA

Testing was performed on the modulation/packet type with the highest conducted output power.
This modulation/packet type was GFSK/DH5.

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2402	11.74	14.928
2441	11.74	14.928
2480	11.78	15.066

Table 35 - Maximum Conducted Output Power Results



Product Service

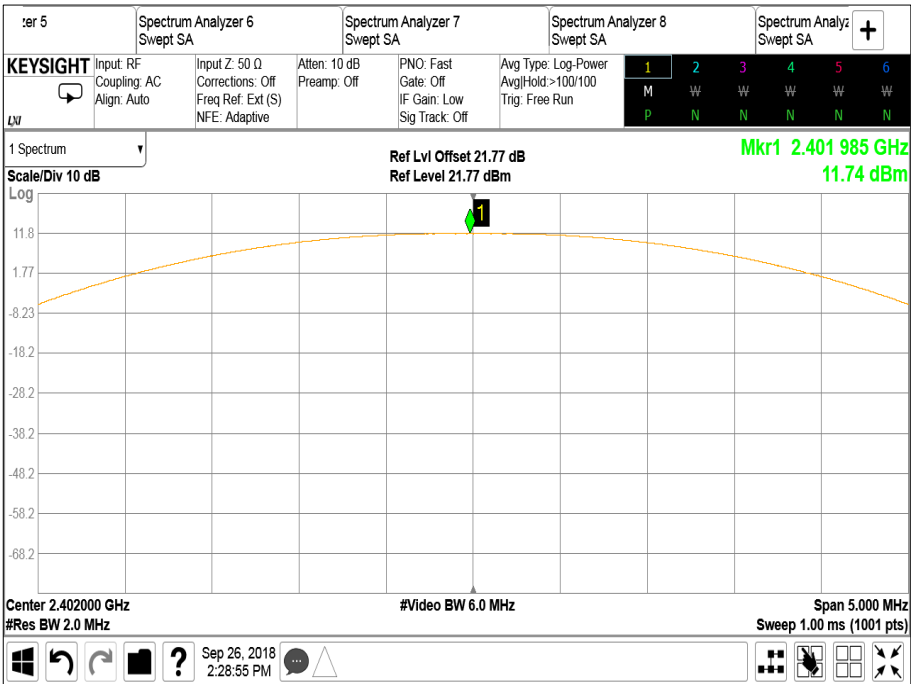


Figure 94 – 2402 MHz - Maximum Output Power

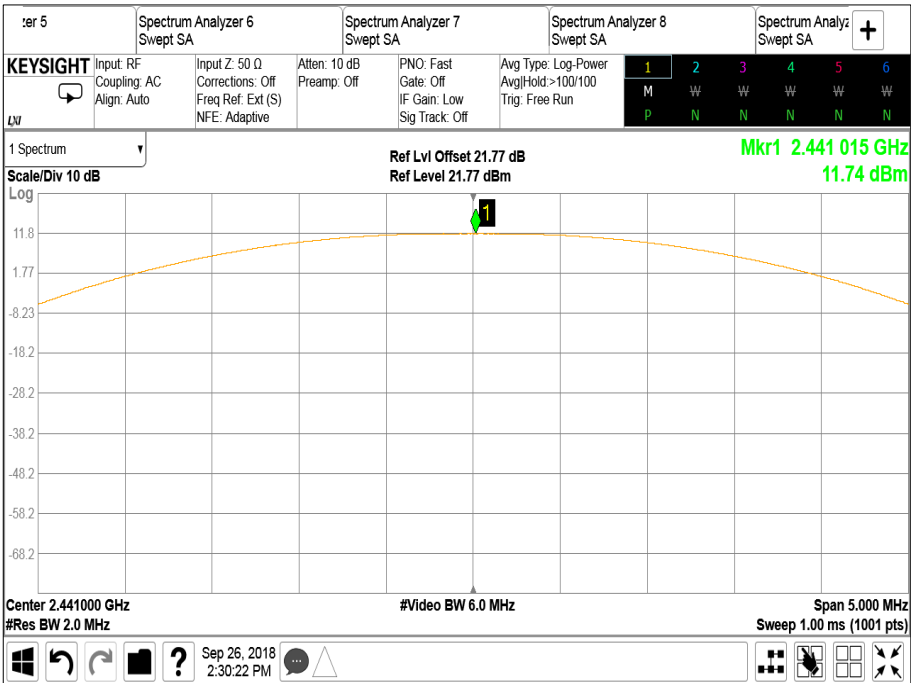


Figure 95 – 2441 MHz - Maximum Output Power

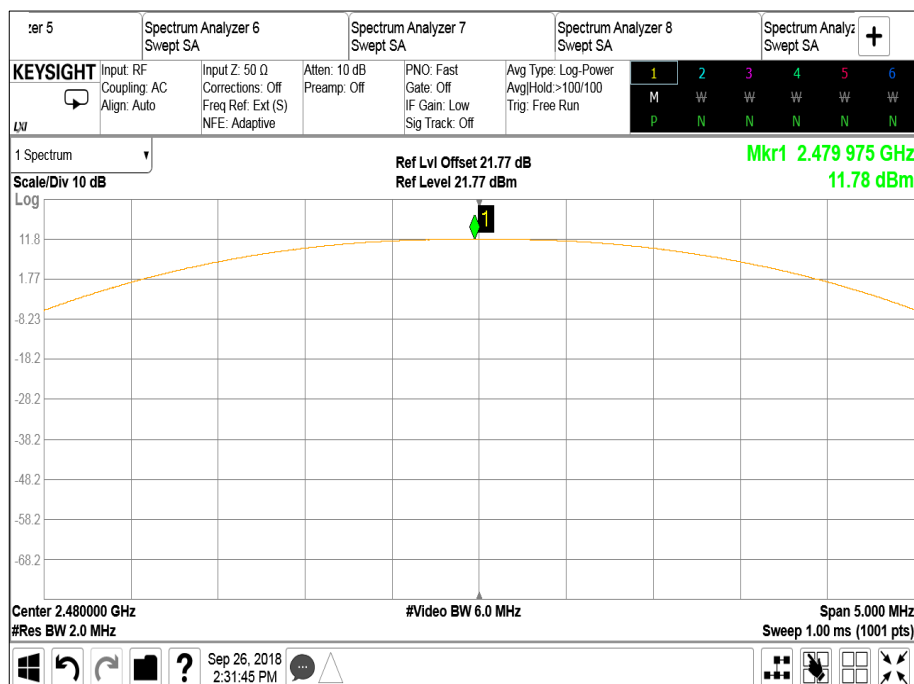


Figure 96 - 2480 MHz - Maximum Output Power

FCC 47 CFR Part 15, Limit Clause 15.247 (b)(1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non overlapping hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Industry Canada RSS-247, Limit Clause 5.4 (b)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channel; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channel. The e.i.r.p. shall not exceed 4 W except as provided in section 5.4(e) of the specification.



Bluetooth EDR - ePA

Testing was performed on the modulation/packet type with the highest conducted output power. This modulation/packet type was $\pi/4$ -DQPSK/2DH5.

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2402	15.18	32.961
2441	15.27	33.651
2480	15.31	33.963

Table 36 - Maximum Conducted Output Power Results

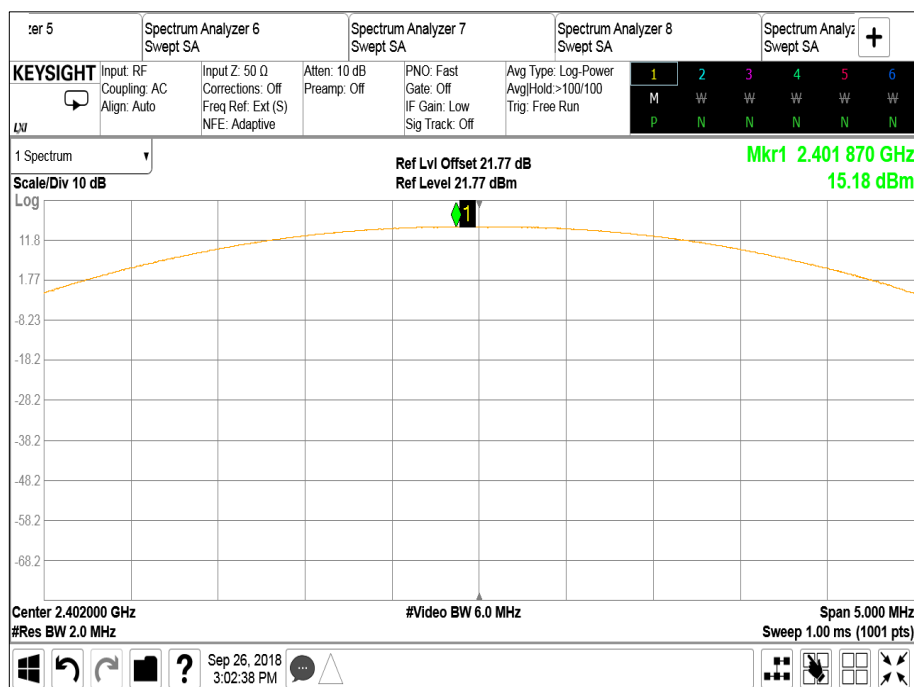


Figure 97 - 2402 MHz - Maximum Output Power



Product Service

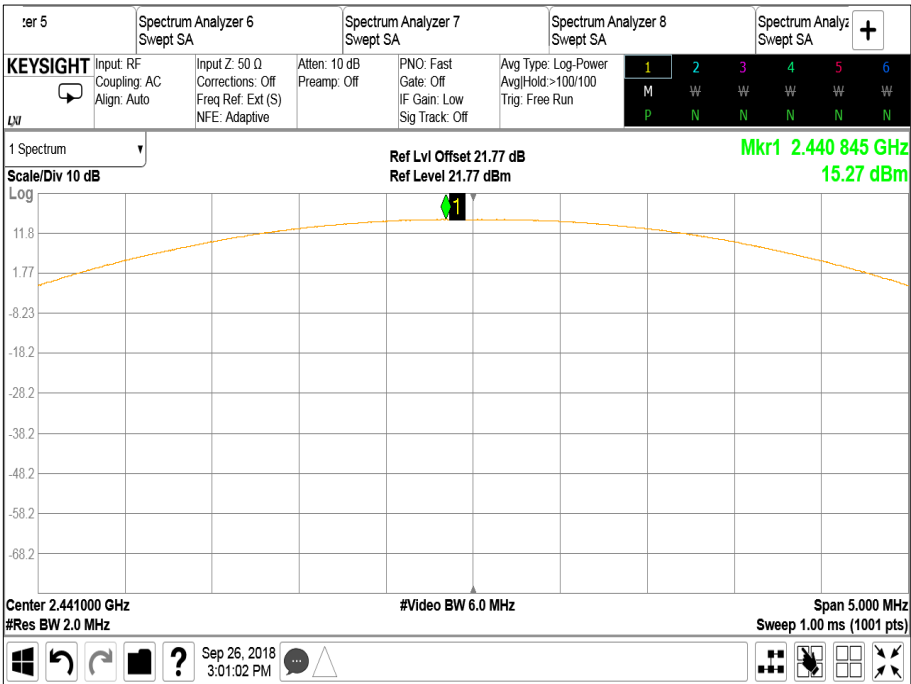


Figure 98 - 2441 MHz - Maximum Output Power

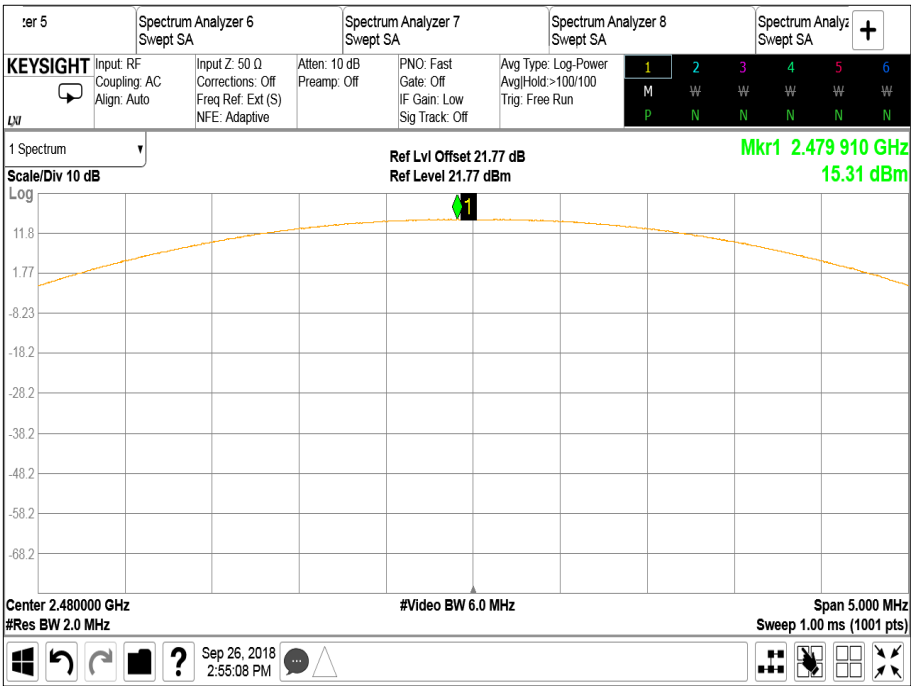


Figure 99 – 2480 MHz - Maximum Output Power



FCC 47 CFR Part 15, Limit Clause 15.247 (b)(1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non overlapping hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Industry Canada RSS-247, Limit Clause 5.4 (b)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channel; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channel. The e.i.r.p. shall not exceed 4 W except as provided in section 5.4(e) of the specification.

2.8.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 37



3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	± 3.2 dB
Frequency Hopping Systems - Average Time of Occupancy	-
Frequency Hopping Systems - Channel Separation	± 30.43 kHz
Frequency Hopping Systems - Number of Hopping Channels	-
Frequency Hopping Systems - 20 dB Bandwidth	± 30.43 kHz
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Restricted Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 38